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BY

MAMIE C. TEX

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FOREWORD

As there is no Eighth Year Agriculture on the market adapted to the demands of our present Illinois State Course of Study, I present this booklet.

It is my aim to adapt it to the use of any class in the Eighth Year following our present Illinois State Course of Study. No pains have been spared to make it as accurate and complete as possible. It is not to be presumed that this booklet contains all that might be said on each topic, but such material is given as the average Eighth Year pupil can understand and assimilate.

In conclusion, this volume is submitted to you, my dear pupils and co-workers, with the hope that it will perform its mission as designed.

MAMIE C. TEX,
Taylorville, Illinois.

September 10, 1925.

FIRST QUARTER

PROPAGATION OF PLANTS; CUTTINGS; INSECTS; FRUITS, AND FRUIT TREES

Home Projects

If the work of the previous year has been supplemented by systematic home project work, the work for the present year can be made much more profitable and interesting. However, if no such work has been done, the teacher can at least map out work for the coming year and start the students to work along independent lines. If any work has been done, have reports made as to the results of such work, check up the separate activities, explaining difficulties, and giving such help as is needed. Encourage students to be systematic about their home work, and see that they keep a record of dates, etc., which will be of use in their school room discussion.

Propagation of Plants

By "propagation" of plants we mean reproduction of its kind.

One of the chief ends and aims of all forms of life seems to be for each to perpetuate itself, to reproduce its species, and if not to multiply its numbers, at least to carry through to a later generation, its kind.

In the vegetable kingdom this is done chiefly in three ways.

1. Seeds. 2. Bulbs. 3. Runners

Our most common garden vegetables are types of the first, as: lettuce, radishes, turnips, carrots, tomatoes, etc.

In the second class, that of bulbs, we find more of this type of propagation among flowers than among vegetables. Most kinds of onions are of this type, while tulips, hyacinths, and many other flowers are examples of propagation by means of bulbs.

Many plants produced by runners are known by the botanical name of "Crytogams," meaning plants that do not produce flowers or seeds. Of this class of plants the ferns are the highest type. These spread rapidly by their creeping root stalks, and every housekeeper who has divided and re-potted her ferns knows how rapidly they spread after this treatment. There is a particular kind known as the walking fern. The new plant is begun by the tip of the frond rooting.

Many seed plants, however, are propagated by means of roots and root stalks. The sedges are good examples of this type of plant which will grow horizontally for some distance, then will send up a shoot which finally becomes an independent plant.

The locust and silver leaf poplar often prove themselves nuisances on lawns from their habit of sending up sprouts which will later develop into independent trees.

Some seed plants renew themselves by means of their branches. Our most common examples of this are the raspberry and blackberry bushes. The branches of these plants will root at the end and thus form new plants. The strawberry sends out long runners which put out roots, and thus propagates itself.

There are many other means by which plants propagate themselves than by these here mentioned, but as they are not met with in the average garden or farm, will be left to the province of botany, where they properly belong. However, propagation of plants by cutting both hard and soft woods will later be discussed, since these may be of practical value in farm, garden, or orchard.

DIFFERENT METHODS USED TO PROPAGATE PLANTS. SEEDS, BULBS, RUNNERS, ETC.

Propagation of Plants by Seeds

In our study of the propagation of plants by means of *seeds*, it may be well for us to understand just what we mean by seed. There is no confusion in our minds when we speak of a peach seed or cherry seed, but when we speak of a grain of wheat or corn as a seed, we are really referring to what is the whole fruit, just as a peach or cherry entire is the whole fruit. Our nuts for the most part are fruits, while what we know as the kernel is really the seed. The so-called Brazil nut, however, is really a seed, with a very hard taste.

In our study of seeds, one of the most interesting and necessary phases of the subject is their manner of dispersal. Nature seems to have endowed plants with almost human intelligence in regard to providing means for scattering the seeds. This is accomplished in two ways—either by apparatus they themselves possess, or by artificial means. Some fruits are known as explosive fruits, so named because when they burst open, when the seeds are ripe, they do so with great violence so that the seeds are scattered to quite a distance. The various kinds of balsams, the blue violet, the witch-hazel and many other common plants are of this type.

Many seeds bear a tuft of hairs or winged arrangement, which will enable them to ride upon the wind for long distances. The maple and dandelion seeds are types of this kind.

Most of us are familiar with our tumble weed. This is so shaped that it will blow for miles, losing but a few seeds at a time. The tickle grass is one of our most common tumble weeds.

Many seeds are so arranged that they will float long distances on water, and are thus scattered to many far-away spots of the earth.

Some of our most troublesome weeds are provided with seeds contained in burrs. These catch in clothing or the hair of animals and are carried, often to foreign lands. It is said that a buffalo was sent as a present to the king of one of the Malay Archipelago Islands. Clinging to the buffalo's hair were many queer seeds—the like of which had never been seen on the island, but in a few years, this plant had soon become a nuisance to the people of the island—all propagated from the seeds in the buffalo's hair.

The edible parts of fleshy fruits serve to attract birds. The birds in turn seize the fruit in their bill, fly away, eat the fruit, drop the seed, and the purpose of the fruit has been accomplished —the seed is given a chance in life, in a place uncrowded by others of its kind.

Neither plants or animals in their natural state make unrewarded efforts for the benefit of other animals or of mankind, hence we can begin to understand why the fleshy part of so much fruit is tempting to both man and animals, while its seeds are either bitter, as in the lemon and orange; hard, as in the cherry and peach, or small and indigestible, as in the berries.

Propagation of Plants by Bulbs

Not a great deal of attention will be given to *bulbs* in this work, because on the average farm they form but a very small part of garden plants. What bulbs are is known to every school child. The onion in the vegetable kingdom and the hyacinth in the flower kingdom are well known types. The bulb is really an underground bud which sends out roots from below. It has overlapping scale, like leaves, and has this peculiarity that its flowers or the bulb itself has a decided odor, as is the case in the lily and onion.

Propagation of Plants by Runners, Called Layering

Runners are another way in which plants may reproduce their kind. Some plants, such as the raspberry, strawberry, and grape, are not readily increased by seeds or cuttings, and only with great difficulty by budding and grafting. Hence they must be propagated in an entirely different matter. This class of plants is usually increased by runners or what is sometimes called "layers." By simply bending a branch into the soil one may

usually accomplish his end. Sometimes it is necessary to hold the branch in place by means of a forked stick. If the bark is thick and tough, due often to a dry season, the branch is partly cut off, with a slanting cut, ending just under a bud. The branch must be buried in moist earth and in seasons of drouth carefully mulched. It is well to make a small excavation in which to lay the stem. Runners may be put down either in the autumn or spring. It may even be done in midsummer if the stalk used is the growing wood, if it is mature and firm. The pear, apple, and quince may also be propagated in this way, and if the work is done in the spring or summer, will usually be well rooted by autumn. This means of propagation is more easily carried out in a wet season, for then the bark is more tender and pliable. Many ornamental trees and shrubs are propagated in this way. The part of plants known as suckers are really spontaneous runners which spring from buds on the roots. The raspberry is largely multiplied by these.

Other means of propagation are: Hard and soft wood cutting, grafting and budding.

Soft and Hard Wood Cuttings

We have seen that most plants are propagated by seeds, bulbs, or runners. While we might say that all plants *might* be reproduced in one of these ways, it would not be true to say that they *all* are. It is just another instance where man has attempted to improve on nature and succeeded. This variation in the means of plant propagation is found in that class of plants which are by nature reproduced from seeds. Grown under the same conditions year after year, seeds will show little or no variation in the plants resulting. But should the environment be changed, conditions of moisture be varied, and, above all, intensive cultivation be employed, new varieties will develop. This is undoubtedly the cause of most of our finest fruits. A pear is a pear, but generations of cultivation have so changed it, that there are now many many varieties, each distinct in shape, color, flavor, and time of maturity. This is also true of the apple, peach, and similar fruits.

All this seems perfectly simple and according to nature, but scientists have found out a surprising thing about seeds. In fruit trees, a seedling—that is, a tree grown from a seed—tends to revert to the original type and not one in a thousand is better or even as good as the tree which produced the seeds. Some other means must then be employed in propagating the kind, and here man begins his improving—on nature process.

The student is not to understand that no improvement of a type is made from growing seeds, for this is just what Van

Mons of Belgium and Knight of England did with astonishing success, but this means is so uncertain and success is met with but once in hundreds and even thousands of trials, that it is most obvious that the markets of the world could not depend on it for the millions of fruit trees required each year to stock the world's orchards.

Cross pollinization has been employed in many experiment stations with wonderful success, but, like seedling, its results were too slow and uncertain for market requirements Hence, it was found necessary to discover some more certain and quicker means of plant propagation. This was done by cutting, grafting, or budding. Every leafbud on a fruit tree, is really an embryo branch, and requires but separate roots to form an independent tree, but there is not enough food material in a leafbud to keep up the growth while new buds and roots are forming. Hence, an entire shoot or *cutting* must be taken. Such plants as the currant, grape, gooseberry, and quince are frequently propagated in this manner. Some trees which have a large pith succeed better if a portion of the last year's growth is taken off with the branch, while in large, strong, woody shoots, success is more certain if the branch is taken off where the branch joins the previous year's growth. Autumn and winter are the best time to make cuttings. The cuttings may be eight to twelve inches in length, and all buds except a few at the upper end removed.

Grafting

Grafting is an entirely different process from cutting, yet its underlying principle is the same. There are many, many ways of grafting. Indeed, there are so many that the average beginner is more than bewildered with their endless number. For this reason, the present discussion will be limited to a brief discussion of the main principles of the work, rather than a general discussion of the various means.

The main difference between grafting and cutting is that in the former process the branch is inserted in a growing stock of a tree, while in the latter, the cutting is put in direct contact with the ground. In grafting, the stock of the tree supplies the roots and sap for the branch inserted, and thus the two become firmly united by means of the new growing wood.

The two things necessary to secure a successful graft is that the sap must have an uninterrupted flow in the grafted branch, and that the forming wood must reach downward without break into the inner bark. Here comes the difference between grafting hard and soft woods, for should the inner bark of the graft rest wholly on the wood of the tree, there can be no upward movement of sap, and hence the graft will die. In soft wood the

line of division is not so small, hence less care is needed with these. But as most of the soft woods are pithy, these are usually propagated by cuttings being put into the ground rather than by grafting process, hence this present discussion will be held to deal only with methods found most successful with the hard woods.

In grafting, four things are essential: The cut must be made smooth and clean, and the two parts brought at once into contact. Second, permanent pressure must be applied so that the parts be held firmly together. Third, the line of division between wood and inner bark of each must coincide. Fourth, the external air and moisture must be excluded until the permanent union has taken place. The latter is secured by various forms of grafting was composed of rosin, tar, and beeswax.

Grafts may be cut in autumn or winter. Those cut in the autumn are usually more vigorous, if carefully packed in a moist place during the cold months.

Veneer grafting is the mode most used by persons who have not made a close study of agriculture, yet it has its good points and is most highly recommended by many. It consists in removing the outer bark of both stock and graft and then bringing the cambium layer of each into contact. The disadvantage of this form of grafting, lies in the fact that great care must be taken to keep the parts in position until the union takes place.

Many people who graft do not realize that union does not take place between the hard wood parts of the branch and stock but only in the growing parts—the cambium layer, and the young sap wood.

Peach grafting is rarely successful, but plub and cherry succeed well when performed very early in the spring. Pears and apples may be grafted later after the buds have swollen. As soon as a tree begins to grow after being grafted, all the buds must be removed from the stock in order that all the sap be sent into the graft. If a larger tree is grafted, remove the buds only from the branch on which the graft is fixed.

BUDDING

Budding is very similar to grafting, and consists in inserting the bud of one tree, together with a bit of its bark, and a little of the wood beneath the bark of some other tree, upon the face of the new growing wood. To bud a branch, a lengthwise slit of about two inches is made in a branch, then a cross cut is made at the top so that the whole cut forms the letter T. The bark only is cut. This is then pressed gently back, and a bud taken off of the present year's growth is inserted. Connected with the bud must be about one or one and one-half inches of bark and growing

wood. This is gently forced down into the T-cut made in the stock, and the whole held in place by some bandage such as raffia.

The bud shoots should be cut when the terminal bud has formed. The bud, after being inserted, remains dormant until the following spring. Then the stock should be cut off two or more inches above the inserted bud. All other buds must be removed, and all the sap is then turned into the one bud. The peach, the apricot, and the mulberry, while difficult to graft successfully, are easily increased by budding.

Annular budding is a method of budding used on trees which have a very hard wood or very thick bark, such as the walnut and magnolia. This is done by taking a ring of bark off of the stock to be budded. Then a corresponding ring with the bud to be used is made to fit the place on the stock where the bark has been removed.

In successful budding there are five things very necessary:

1. One must have a thrifty growing stock, whose bark peels easily.
2. The time must be right. The cambium layer must be just right to insure success.
3. Buds must be well matured.
4. A sharp knife must be used in order that the buds will be properly cut.
5. A proper amount of pressure to hold the bud in place.

Summer is the best time for budding, while spring is the best time for grafting. Budding is simpler than grafting and the beginner is apt to have better success with it than with grafting. It is the chief way of increasing our peach trees, since grafting is rarely successful in the North on peach trees. Grafting, however, has this in its favor, that it will succeed on older and less vigorous trees. Grafting also requires less care afterwards, since no ligatures need be removed, nor do the stocks have to be later headed down.

Before one can become successful at this work, he must first realize the limitations as well as the possibilities of budding and grafting.

At one time it was believed that grafting could be performed between every species of trees and shrubs. We know this to be untrue. Success is more certain if the graft and stock are closely related. Varieties of the same species unite the most freely, as a pear grafted onto a pear. Species of the same genus come next, as a pear grafted on a quince.

Genera of the same natural order show the least success in grafting, as a pear on an apple. Beyond this, success is impossible, as a pear upon a plum or cherry tree.

However, there are exceptions to this, as to every rule; for instance, most species of cherry cannot be grafted on the wild cherry, though they are of the same genus.

In order that no confusion may arise in the pupil's mind as to the value of grafting, it is well to point out that seedlings or inferior stock may be made valuable and productive by the process. One good peach tree will supply enough buds to eventually produce a whole orchard of fine trees.

Another advantage of grafting may well be mentioned. Many kinds of trees—as, for instance, the Grimes Golden apple—usually have a comparatively short life, while if they are grafted to other sturdy stocks, their bearing period may be increased years.

Strange as it may seem, the budded or grafted shoot never partake of any of the characteristics of the stocks upon which they grow. They run true to their parent tree. Instances are on record where nurserymen have traveled across continents and paid thousands of dollars for a single tree of superior fruit. The buds from this tree may make it possible for people almost all over the world to enjoy the flavor of this particular variety, while if it were not for budding or grafting, the market could be supplied from but one tree.

Budding and grafting are fascinating work, and may be very successfully performed by the students on trees around the school grounds. Encourage them to try, especially if young timber is near. Government bulletins are available on the subject, and the student should be encouraged to send for and to read them.

No part of the farm holds greater possibilites of pleasure and profit than does the orchard. Care of the orchard is pleasant and easy, and can be seen to when other work is slack. Therefore, the students are urged to experiment on trees on their home grounds and then report progress in later months to the class.

Care of Cuttings; Forming of Callus and Roots; Transplanting.

If we wish to make a cutting, we remove a part of a stem with at least one well developed bud. This may be put into warm moist earth or into water. After roots have formed, we may then transplant it to its permanent place of growth. In this way geraniums, verbena, heliotrope, nasturtium and many other flowers may be propagated. Usually it is best to have at least two or three joints or nodes to each plant. If there are several leaves on the plant they should be removed to prevent too much evaporation. As soon as the roots are an inch or more in length the cuttings should be transplanted into permanent places.

Currant, grape, gooseberry, and flowering shrubs are among the hard wood class. These are generally cut in the fall and packed in green sawdust or damp sand till about February or

March, when they may be started in the house or even left till later and placed outdoors, in well prepared soil. There should be at least two or three nodes to each plant and planted so that at least one node is above ground.

Potatoes, sweet potatoes, and sugar cane are nearly always propagated from cuttings. In considering this, we must recognize that a potato is but a swollen underground stem, and therefore, when we plant a potato, it is really a cutting.

When we make a cutting of a geranium, for instance, we either place it in water or in moist earth. If we put it in a glass of water, we more readily see the changes which take place at the lower end of the branch. Extra layers of cells begin to form here, called a callus. They have a peculiar grey color and give the stalk a swollen appearance at the cut end. From this callus come in a few days very fine white thread like roots which develop later into heavier growths.

Some plants develop roots much earlier than others, while in some instances roots fail to form at all.

How to Care for the Plants.

When roots have formed of sufficient strength and length to make it safe to transplant the cutting, this should be done with great care. The earth should be moist, warm, and finely powdered. In this the young plant should be carefully placed, with the roots so placed they will neither be bent nor broken. If exposed to direct sunlight, they should be covered for several days. Newspapers held down by heavy clods or bits of bricks are adequate protection.

Advantage of Raising Plants from Cuttings.

There are several advantages in raising plants from cuttings. The chief one is perhaps the time element. Raising them from seeds would require a great deal longer. Another advantage is that of economy. One tree will yield cuttings for grafts or buds enough for a whole orchard. Another advantage is that by budding and grafting, we may use stalks of really inferior fruits, but by using good buds or grafts we may in the end have a fine variety of fruit.

Projects:—Make a Propagation Box, A Window Box

It is suggested that the girls of the class have charge of the window box, and the boys of the propagation box. In the former have geraniums, which have been propagated by cuttings, while in the latter have various kinds of berries, and such bushes as the boys have propagated by cutting or layering.

INSECT LIFE

Special Attention to Insects Encountered in Connection with Farm and Garden Projects

In the beginning the study of insects, it is well to recognize clearly at the start that all insects are not pests, but may be of actual benefit to the farmer or gardner, and that some insects may be pests under some circumstances and an aid to the farmer under other conditions. Keeping these two ideas clearly in mind, let us take up the study of insects in general.

As we all know, the animal world is divided into many classes, at the head of which stands man, the human animal. Much lower in the scale of life comes the insects, "Insecta," as they are biologically known, from the Latin verb insecare, meaning "to cut." This name is applied to them not as some of you may think because of their bad habits of cutting and eating things, but because of the peculiar shape of their body. They have three clearly defined body regions, *head, thorax* and *abdomen.*

Catch a fly and examine it closely. You will find it to have three separate parts to its body. Most insects have only three pairs of legs, and usually two pairs of wings. Most of them have antennae or feelers which project from the head, usually near the eyes, which are nearly always very prominent. The hind legs are always the largest and best developed.

Just as the animal kingdom is divided up into numerous divisions, just so is the insecta class, divided into subdivisions.

Under the insecta class, we may include bugs, beetles, bees, flies, butterflies, moths and many others.

For the most part, we let the word "bug" cover all class of insect which we find on farm or garden. But while this term is a convenient one, it is by no means a scientific one. nor is it a just one, for the various forms of insects have their peculiar characteristics, likes and dislikes, just as human beings do, and it is only by studying these, that we can come to any clear idea of the treatment each kind will require.

Since an ounce of prevention is worth a pound of cure, it may be well to find out, if possible, what will prevent an attack of garden and farm pests.

Men who have made a study of the subject for years, find that *proper cultivation and the observance of hygienic principles are the best possible preventatives for all pests to which one's garden lays liable.* These men have found out that the cultivation of large areas of any one crop, too close crowding of trees and plants, forcing, and lack of proper cultivation are the chief aids to plant pests of various kinds.

When one stops to consider that each year the loss to vegetable crops through pests is fully 20 per cent of the entire crop, one sees how extremely necessary it is that farmers possess a better knowledge of ways and means of combatting these nuisances. The "up-to-date" farmer knows that *many pests may be checked or wholly eradicated by improved farming methods.* He also gives consideration to *the time and place of planting,* and that crop rotation is not only beneficial to the soil but most destructive to many pests. Burning over fields after harvest is one way to destroy such pests as live above the surface. Cut worms, aphids, grasshoppers, some bettles, and many other insects which live on or near the surface may be destroyed in this way.

The boll weavel of the South taught the farmers of that section the necessity of diversified farming to control this pest. They have found that crops of different kinds must be grown, or cotton raising will have to be given up entirely. Fall plowing and cultivating are other methods of eradicating pests. Disking has been found especially effective against the fall army worm. Another help to the careful farmer is coöperation with his neighbors. For a man to attempt to combat successfully pests which sometimes sweep over whole counties, is utter folly; but the united effort of all the farmers of a section may do much to destroy the invader before much harm has been done.

But perhaps *the two greatest aids in combatting farm pests are clean methods of farming and constant vigilance.* Weedy corners in fields, piles of trash, and unburnt rubbish, and unplowed fields are merely invitations to insect enemies. Constant watchfulness on the farmer's part will more than repay for time and trouble. A pest which today may be merely making its appearance, in forty-eight hours may be beyond control. Usually, the appearance of pests will be first noticed along the edge of fields.

Perhaps *the most common pest with which the average gardeners have to deal with is the cut worm.* Sooner or later anyone who attempts to raise a garden will come across this enemy, for he is known as a "general feeder"—that is, he eats almost everything. There are numerous species of this pest, and they rank as one of the greatest enemies of the American gardener. They are especially destructive to such plants as tomato or cabbage, which must be reset, also to young corn or potatoes, which are just coming above the ground. They are the larvae of the owlet moths, and work at night. There are so many species of cut worms that it is impossible in a work of this scope to describe all of them, but all have the same soft,

smooth, round body, varying from light grey to brown or even black. Some are spotted or marked with stripes. They work at night: then they lie curled up in the ground near the plant they have destroyed, until the next night, when they feed again on some other plant.

The eggs are usually laid on grasses and weeds, which spring up in the fall after the crop is harvested. These hatch out, and the larvae feed until cold weather drives them into the ground. Later they enter the pupa stages, which vary in length for from three to even eight weeks, then hatch out as moths.

The "greasy cut worm" is so called because of its greasy appearance. It is a dull, dirty-brown color, with greenish undersurface. It will eat any part of a plant, and often cuts down plants six or more inches in height. It generally cuts them about one inch above the ground. The "granulated cut worm" is so called because of the very small, round, black spots which cover its body. The "variegated cut worm" is one of the most destructive of all and is so called because of its mottled appearance.

There are many methods of combatting cut worms, and circumstances must decide the method to be used. Bran mash or young clover treated with Paris green often prove effective as poison baits. Another way to prevent injury to young plants is to wrap the roots of the plants in paper before resetting. Bordeaux mixture has been found very effective in treating this pest. If the plants to be watched are few in number, hand picking is to be advised.

The army worm and fall army worm required much the same treatment as ordinary cut worms. In farm fields infested with these pests, it is often necessary to burn over the whole field, while fall plowing and thorough cultivation will also do much for their destruction.

These are two forms of caterpillars not included in the cut worm class—*"naked and hairy caterpillars."* However, as most of them feed on useless plants they are of little interest to this work.

The *"garden webworm"* is an example of pest which is a pest only under some conditions. It usually feeds on useless vegetation, but may attack garden crops. It is so called because it draws together edges of a leaf, by means of a web, thus making a shelter from where it crawls out only when it feeds. Paris green has proved a very effective remedy for this pest.

The beetles are among our most destructive insects. The leaf beetle takes many forms, the twelve-spotted cucumber bug being the most common in this region. The flea beetle is so called from its habit of jumping from one plant to another.

The potato flea and cabbage flea are well known types of this pest.

Arsenical and Bordeaux mixtures are recommended for ridding one's garden of these insects.

Other bettles found in vegetable gardens are the Blister Beetles, Striped Blister Beetles or Potato Bug, and the Three-lined Blister Beetles.

These are especially destructive to potatoes, beans, peas, beets, tomatoes, melons, radishes, cabbage, and squash. The old hand method of "bugging," or the use of Paris green are standard remedies for this pest.

Grasshoppers, locusts, crickets, and katydids are all closely related. Grasshoppers are migratory or non-migratory, the former being the most harmful. They develop in enormous numbers, and move in such numbers that they darken the face of the sun. These raids occur most often in semi-arid regions. The red-legged locust is one of the most common of our grasshoppers. *The Rocky Mountain Locust is one of the most destructive of our locusts,* and it was to its work that during the years 1874-7 Kansas, Nebraska, and neighboring states owed their enormous loss in crops. The differential locust is usually found along roadsides and in timber lands, and when it enters fields, it becomes very destructive.

White grubs are another pest with which gardeners have to deal. As there are several hundred distinct kinds of grubs, they will be treated as a class. They may be described as soft, large, whitish, or yellowish worms, bodies wrinkled, and somewhat hairy, yellow or brown heads, with the body enlarged at the back portion. They usually are curled up almost in a circle, and crawl on their sides. They are the larvae of the June beetle, a large, shinning, brown beetle, known to every one from its habit of flying into lighted rooms at night and bumping against walls and ceilings. In the larvae stage, they are very destructive to grasses and root crops, also to corn and young trees. The beetles also cause much damage to foliage of young orchards, where they feed at night. In infested fields, fall plowing is an effective aid in their extermination. Rotation of crops should be so planned that beets, corn, potatoes or other crops which are subject to injury from the white grub should be followed by crops that are immune.

Wire worms are another pest with which the farmer is often confronted. They are the offspring of the click beetle or snap-bugs, which are so called because of the peculiar habit they have of leaping into the air with a sudden snap when they fall upon their backs. They feed on various vegetable crops, such as potatoes, turnips, etc. The worms are wire-like, smooth,

nearly round, hard, and yellow or reddish in color. They are exceedingly hard to kill and do not readily yield to any known remedy.

Among the most widely known plant pests are the *aphides, plant lice, leaf hoppers,* and other related forms too numerous to mention. These all secure their food by suction. They are usually soft-bodied and green, very small, with long legs, antennae, and often thin, gauzy wings. The melon apis is one of the best known of this type. All of them live through several life cycles each year. For the most part they are found on the under surface of leaves, but some feed on roots, as is the case with the grape phylloxera, which lives underground and produces galls. Kerosene emulsion is one of the best known remedies for these pests. Tobacco extracts are also good, but each must be applied in a fine spray to the underside of the leaf.

Necessary Equipment for Insect Study. Vivariums or Insect Cages, Pint and Quart Jars

Each pupil should have a glass in which to keep his live specimens.

The equipment for insect study may be as simple or elaborate as one wishes, but home made equipment will result in quite as good work as the more elaborate preparation. In some instances it is desirable to keep the specimens alive and existing under as near normal conditions as posible. For these a *wide netting box is recommended.* This may be made by the boys of the class and covered with ordinary wire screen. It may vary from a few inches square to the size of a large hat box. The larger size is recommended if branches, or leaves are to be placed within, and the animal's feeding on them observed. *Ordinary pint of quart fruit jars* are of use but unless air is admitted in some way the specimens soon die. For this reason, the glasses with tin covers, in which one buys peanut butter or such foods, is recommended. In these the insects may be kept, and holes punched in the lids to admit air. A good *magnifying glass* is also recommended, one being enough for 5 or 6 students.

There should be an ample supply of *cardboard and laboratory pins* for use in mounting specimens. A *cyanide insect bottle* for killing specimens is also of use, as are insect cases for preserving them. Be sure to label each specimen as to the time it appeared, and disappeared.

Garden Pests

The following list is by no means complete, but may help the amateur gardener locate and exterminate some of his more common enemies.

Asparagus beetle is slender, blue black in color, red thorax, yellow or dark blue wings. It is about one fourth of an inch in length and may be held in check by destroying parts of plants infected with the larvae, or eggs. Fresh air slacked lime applied early in the morning is also good.

Pea weevil is about one-fifth of an inch in length, is black with white and brown markings. It lays its eggs in the green pea, these hatch into larvae, and when the pea is planted develop into beetles. Late planting and holding seed over a season are both recommended as remedies.

The bean weevil is closely related to the pea weevil. Unlike the pea weevil, many generations will spring up in the same seeds, hence, the beans must be fumigated or subjected to heat. Weeviled beans should never be planted.

The Seed Corn maggot attacks and scrapes the roots, stalks, and stems of plant underground. Its parent looks like the common house fly. Beans, peas, and corn are most severe sufferers from it, but cabbage, turnips, radishes, beets, and other vegetables frequently are destroyed by it. Mineral fertilizers help to check its spread; hellebore and carbolic acid emulsion are also good, while hand picking is especially effective.

The Spinach Flea Beetle is black with a reddish-yellow thorax. They are especially destructive to beets.

The cabbage is a vegetable especially liable to attacks from pests. *The cabbage maggot*, an imported pest, is becoming more troublesome each year. Carbolic acid emulsion has been found to be effective. Hellebore applied around the roots has been found good also. The cabbage worm is the worst of all garden pests. The white butterfly is its parent. The female has two black spots on its fore wing, while the male has but one. The best remedy is Paris green, and should be used when the plants are first set out. The worm itself is green, soft, and burrows into the heart of the cabbage.

The Striped Cucumber Beetle measures about two-fifths of an inch in length. It is yellow, striped with black, and black head. They attack cucumber, squash, and melon plants early in the season. Lime is one of the best known remedies.

The Squash Vine Borer is hard to detect, but the presence of a yellowish-brown powdery excrement which it drops from its place in the stem of the plant will denote its presence, as well as the sudden wilting and dying down of the leaves. The parent is a clear-winged moth. The outer wings are a bright olive brown, with greenish reflections. The body is marked with red, orange, black, and bronze. The larvae look much like grubs. Fall harrowing and spring plowing are beneficial in exterminating this pest, and squashes should not be planted on

ground in two successive years, if these bugs are known to be present.

More species of pest attack corn than any other known vegetable. Over two hundred are known to attack the corn plant. Of these about twenty attack the seed, almost thirty the roots, about eighty the stalk, about one hundred twenty the leaf, about twenty the tassel, and nearly fifty the ear. The others attack the dried ear. Among the pests the most common are:

The Corn Root Aphis, which is a bluish green, and caused injury while the plant is young, resulting in wilting, and stunted growth.

Corn Root Worm is slender, thread-like, and soft, white or yellowish in color, and it feeds on the underground stems. Its parent beetle is yellowish green, wings marked with twelve black spots, known sometimes as the twelve-spotted cucumber beetle.

The Common Stalk Borer is sometimes called the heart worm. It works in the corn stalk, and also attacks tomatoes, potatoes, peppers, and other vegetables, and some flowers.

The Corn Ear Worm is almost too common to need mention. It works at the tassel end of the ear, and soon leaves the ear in a disgusting condition.

Keep a Chart

Each pupil should keep a chart record of insects brought into the school room. The record should show the name of the child, name of the insect, and whether it is a pest or beneficial insect.

Special Study of Cabbage Worm; Butterfly, Life History

All insects hatch from eggs just as many other animals do, but they have various forms during their life. For instance, when a butterfiy or moth is young it has a worm-like body, and is called a caterpillar, or larva. This larva grows rapidly, and soon passes into the *pupa* stage. In this stage, it may be inclosed in a silky cocoon, or in merely a sort of hard shell. During this period it lies dormant, and eats nothing. Sometimes it lies there for days, weeks, or even throughout the winter. When it hatches, it is an adult insect, which it turns lays eggs (if a female) and thus the life cycle is completed.

In the case of the cabbage worm, it is the larva of the well known white butterfly we see fluttering over the cabbage patch. The worm is greenish in color, covered with a fine down and tapers to one end. It lays its eggs on the leaves of the plants, where they hatch in ten days, and then the larvae feed on the

cabbage for about three weeks. The pupa stage lasts about two weeks. There are generally two generations each season—one in May and one in July.

The best remedy is to use Paris green on the plants when first set out.

Tomato Worm

The tomato is frequently injured by a large caterpillar called the tomato fruit-worm (Heliothis obsoleta.) This is the same as the enemy of tobacco known as the bud worm, and also feeds on corn and cotton, where it is known as the corn ear worm and the cotton boll-worm. The larva eats into the tomatoes and often destroys large numbers of them. To control them the land should be plowed in the fall, and the plants powdered with arsenate of lead.

The tomato worm is another tomato pest. It is a large green caterpillar about three and one-half inches long. The moths are large. They appear from May to June. To control, hand pick the larvae.

Squash Bug

The squash bug unlike the cabbage worm, does not pass through complete changes of form. Like the grasshopper and cricket they have the same form as when first hatched, except that the young have no wings. These insects molt or shed their skins several times; each time their wings grow larger. This finally results in a complete set of wings.

Other Insect Pests

The codling moth is one of the most injurious of the cutting insects. The adult is a small grey moth about one-half inch in length. It lays its eggs on the leaves or the the fruit of the apple tree. These hatch and the larvae eat their way into the apple. Then the larvae work their way out crawl down under the bark of the tree from which they come out as adult insects. The larvae we are all familiar with as the white worm found in apples. If the young fruit is affected, it will fall; if it isn't, it remains on the tree to become a stunted deformed wormy fruit. To destroy this insect, spray the trees as soon as the petals fall, but before the calyx tubers close. Lime sulphur mixture or Bordeaux mixture and arsenate of lead are recommended as sprays.

The potato beetle is another well known pest. Its eggs are laid on the underside of the leaf. These hatch into small larvae that feed on the leaves, the pupa stage follows, then comes the perfect insect, commonly called the potato bug. It is about one-half inch long and has ten stripes along the back. Spray the potato crop with one pound of Paris Green to the acre.

The cucumber beetle is a little small striped beetle which feeds upon the leaves of the young plant. They can be killed by spraying with arsenate of lead compound. The larvae sometimes attack the roots of the cucumber. They also feed on watermelon, squash and muskmelon vines.

Field Pests, Corn Worm, Aphis, Hessian Fly, Etc

There are several worms injurious to corn. Among them are the wireworms, army worms, cutworms, white grubs, sod webworms, corn bill bugs, chinch bug, stalk borer, seed corn maggot, corn ear worm, corn root aphis and the northern corn root worm. Some of these have been discussed already. The corn ear worm (Heliothis obsoleta) is perhaps the most common. It is sometimes known as the cotton boll worm, the tomato fruit worm, or the tobacco false budworm. It is variable in its markings but is usually dull greenish or brown in color.

There are various kinds of *aphididae* which attack apples, beans, peach, plum, cabbage, cherry, clover, corn, cotton, grapes, melons, peas, potatoes, apples, spinach, strawberries, wheat, and other vegetation. The corn root aphis is bluish green in color, and sucks the juice from the roots of corn and many other plants. These aphididae are cared for by colonies of brown ants, which live off a sort of honey secreted by the aphis. The best way to control the aphididae is to plow up the field in the fall, thus destroying the nests of ants. The aphis can not live without the ant to care for it.

The Hessian fly is one of the chief enemies of our wheat fields. It is a tiny two-winged gnat, one-tenth of an inch long. It emerges in the fall, and lays eggs on the upper surface of the leaves. The maggot goes down into the leaf sheath, and forms a brown looking knot—known as the flox seed. This hatches in the spring into other flies. It passes the summer in the wheat stubble. One method of destroying them is to plow under the infected crop. This is expensive but effective Fall plowing, burning over of fields in the fall, rotation of crops, and clean farming are recommended to check the Hessian fly ravages.

Discussion of Chinch Bug and Treatment

Chinch bugs are the worst enemy of wheat and corn among the insects. They are small dark colored, with white wing covers. They damage the grain by sucking the sap from the plant in much the same way as the Hession fly. The adult bugs live through the winter, and lay their eggs in the spring. When the young first hatch they show a reddish color. No real method of control is known. All infected fields should be burnt over each fall. This

is especially important as it not only destroys many of the insects, but also their hiding place. Furrows filled with oil have afforded some protection. Neglected fields are their breeding places.

Pests of the Home, Ants, Roaches, Etc.

There are many varieties of ants but the most common pest of the ant family that bothers the house is the little red ant known as the house ant. It is less than one-sixteenth of an inch long and proves a great nuisance by running over food, getting into sugar, cakes, etc. Its nest is usually in the walls of the house or in some place exceedingly difficult to reach. A drenching with boiling water or bisulphide or carbon may serve to destroy the colony, if the nest can be reached. If not, a sponge should be dipped in strong sugar water and placed on a saucer in the pantry. As the sponge fills with ants it can be dropped into boiling water and the ants thus killed Persian insect powder or carbolic acid sprayed across the line of their travel may aid in ridding the place of them.

Another variety is the large black ant. This is quite destructive, and consumes great quantities of food. It has it nest usually in rotted wood somewhere in the concealed part of the house.

There are many species of cockroaches. The small so called German roach is widespread, and abundant in the cooler parts of the South. It was first seen in the United States in New York City about the time the Croton aqueduct was opened and was called the Croton bug, for it was believed to have come with the water supply.

Roaches will eat almost anything—animal matter, cereal products, paste, glue, bread, etc. Roaches are found only in warm places, being unable to withstand the cold. Of the larger kinds, we have three varieties the Orientalis roach, the Periplaneta australasial or Australian roach and the Periplaneta Americana or the American roach. They are always numerous on ship board, around bakeries, sugar refineries, and such places. They like a warm damp place to breed. Absolute cleanliness is the best preventative. Great care should be taken to keep soiled clothing in tight containers, to air and dry all dish and mop cloths, and to keep pantries and kitchens clean, light, and airy. There are many good powders on the market. Borax is good as is also black flag.

Insects that Cause Human Diseases; House Fly; Mosquito; Campaigns

Probably the most common and dangerous household pest is the housefly (Musca domestica). It is probably a native of India but has followed man to all parts of the world. While it always

occurs where human habitation is established, it is never found elsewhere. It is closely related to the stable fly which originated in Africa and is a blood sucker. The house fly can not bite nor is it a blood sucker. It breeds preferably in horse manure, and this is its favorite larvae food. Because of its filthy habits of feeding on filth then lighting on clean foods it has come to be one of the most dreaded house pests. It has been shown to be a very common carrier of typhoid germs, especially in Southern countries where food is exposed to flies then eaten. Another way it may infect food is at dairy farms where sufficient care is not taken. Infantile diarrhea and summer complaint are also caused sometimes by flies. It was at one time thought that the stable fly carried the germ of infantile paralysis, but its is now not thought to be the case.

African sleeping sickness little known in our country, is caused by certain biting flies known as the tsetse fly, which belong to the same family as the house and stable fly. But the genius Glossina in which these flies are included is restricted to the African continent.

Of recent years, it has been found how dangerous flies are and steps are being taken to control them. Borax, hellebore and a fertilizer consisting of calcium cyanamid, acid phosphate, and kainit, are very destructive to the larvae of flies in horse manure. Yet these do not harm the manure as a fertilizer. These are used on manure piles. Also fly traps have been perfected for use over manure piles. The housefly develops only in alkaline material, hence if acidulated, it eliminates it as fly food. Much money is also spent in screens, fly swaters, fly paper, fly traps, yet there has been no great diminuation of their numbers. To accomplish any great benefit, campaigns must be national instead of local.

Mosquitoes like flies are found almost all over the world. They are known to be responsible for such diseases as malaria fever, yellow fever, dengue fever, filariasis, etc. Of these, the best known is ague, or malaria fever, sometimes called the chills. It was the first human disease traced to an insect carrier. The growth of the germ in the human system is complicated. The parasitic organisms exist in the blood of persons suffering from malaria. This blood if taken into the stomach of the germs Anopheles undergoes certain changes and later penetrate the walls of the stomach. From here they find their way to the salivary glands. Twelve to twenty days are required for these changes to take place in the body of the mosquito. The germs remain virulent for several weeks and if the mosquito bites a person during that time, the malaria germs are introduced into his system, and malaria may result.

Quinine is a specific for the disease, and should be taken if one is in a malaria region. Draining of swamps and ponds, and the elimination of all stagnant water is the surest method of getting rid of the pest, the mosquito. Such campaigns are usually carried on locally. Where rain barrels are used, sprinkle coal oil in the water to kill the wiggle tails and thus prevent mosquitos.

Control of Insects; Poison Sprays; Protection of Birds

Methods of combatting insect pests are numerous, many of which have been mentioned earlier.

Co-operation by farmers and truck gardeners is one of the most effective if the pest occurs in large numbers. But to do this effectively, it is necessary that one know the habits, characteristics, and life cycle of the insect to be exterminated. In some cases *clean cultivation, fall plowing,* and *rotation of crops* will prove beneficial. Care should be taken to not plant crops on soil known to be infected with insects which feed on that particular crop. If the space to be covered is not too large, there are many effective *insecticides* which may be used. Some may be prepared at home, but as most of them are on the market, unless they are required in quantities it is often cheaper and more satisfactory to buy them already prepared. There are two classes of insecticides—known as *external or contact poisons* and *internal or stomach poisons.* The former are effective in cases where the pest has a delicate, thin body covering, while the latter must be resorted to when the former is not effective.

Paris green is one of the most useful of the internal poisons, and may be used in the dry form, or in a solution. The latter is applied as a spray, and is made by using a pound of Paris green, a pound of lime with seventy-five to one hundred gallons of water. The strength of the solution must be varied for the plants to be sprayed, delicate foliage requiring the weaker solution.

Arsenate of lead is less harmful to growing plants, and quite as effective as Paris green if properly used. It is usually in a paste or putty form, and must be worked in a little water before being added to the spray tank.

London purple was at one time much used but is no longer recommended, as it is almost impossible to get it pure, and if adulterated, is apt to be caustic and burn tender plants.

Arsenate of copper is less readily procured than Paris green, but is more rapid in its effects.

White arsenate is dangerous when used alone in solutions, but is excellent to prepare poisoned baits for cut worms, and grasshoppers.

Arsenate of lime is made by boiling one pound pure white arsenic, two pounds lump lime, and three gallons of water. Dilute with two hundred gallons of water before using as a spray.

Some have raised objections to using arsenical preparations on vegetables soon to be eaten, but experiments have shown, that vegetables so sprayed are by no means dangerous. Gillette has shown that a person would have to eat twenty-eight cabbages at one time to get enough poison to harm him, if the cabbages were sprayed in the ordinary way.

Lime is one of the best aids of the farmer in preventing insects. It is especially effective against soft, moist insects. It kills by contact, by burning holes in their bodies. It is useful in combatting many larvae, slugs, and snails.

Gas lime is especially good for use on ground infested with white grubs. It should be applied in the fall after the crop is out, at the rate of four barrels to about one hundred square feet of ground, or one and one-half tons to the acre.

Hellebore is less dangerous than insecticides containing arsenic, hence is often recommended for vegetables which will be eaten soon. It is used for slugs, cabbage worms, and related pests. Use as a spray, one-half an ounce to two gallons of water.

Of the contact poisons, *kerosene emulsion* is perhaps the best for such pests as plant lice, plant bugs, and soft-bodied insects. It is made by using two gallons of kerosene, one-half pound of whale oil soap, and one gallon of water, one quart of soft soap may be substituted for the whale oil soap. This emulsion should be diluted with from fifteen to twenty parts water. Sometimes a stronger solution may be used to advantage. One disadvantage in using this remedy, is that it is necessary that it come in contact with the pest, and this necessitates spraying the under sides of the leaves.

Carbolic acid emulsion is prepared by using one gallon of water, one pound of soap, one-half gallon of crude carbolic acid. This must be diluted with from twenty-five to fifty parts of water. It is used against root maggots, on corn, cabbage, onions, etc.

Formalin is recommended in treatment of the potato scab. Use eight ounces to fifteen gallons of water.

Both hot and cold water are effective insecticides. Ice-cold water is especially good in treating plant lice, while water heated to a temperature of one undred fifty can be applied to plants with little damage to the plant but much to the pests.

There is still another class of insecticides which kill by

suffocating the pests. *Pyrethium* has been carefully tested and found to be very effective against certain forms of aphides, small plant bugs, and household pests.

Tobacco comes under this third class, and will be effective in certain cases but is being less used than formerly. Nicotine extracts are growing in favor, and are good to use against aphides, white fly, thrips, and other soft-bodied bugs in green houses.

Sulphur is applied either alone as a specific against the red spider, it is mixed with air slacked lime, or with the kerosene soap emulsion.

NOTE.—*This list is by no means a complete one—it is merely suggestive, and it is hoped that the student will be interested enough to read up in various farm journals and compile a more complete list of insecticides needed in his neighborhood.*

Natural Foes of Insect Pests

Two of the greatest foes to garden pests are *chickens* and *toads*. A flock of chickens or turkeys will do more to clean out grubs and related pests from a field than many expensive contrivances. Toads also help the farmer in his fight, and for this reason should be protected.

Most birds are insectivorous and should for this reason be protected. This is also true of reptiles.

Against locusts, turkeys are especially effective. *Pigs* are very fond of white grubs, and if turned into a field will soon rid it of these pests. Chickens, if allowed to do so, will often follow a plow all day, feasting on the grubs as they are plowed up. The Tachina fly, wasps, mites, and predaceous ants are also enemies of the white grub.

Ducks are fond of the asparagus beetle, and are valuable aids in ridding one's garden of this pest.

But in his fight on pests of garden and farm, the farmer is often aided by a class of helpers of which he too often knows nothing. These are insects known as natural enemies, and either devour, or prey upon as parasites, upon the garden or field pests. This is true in the case of the cabbage worm, which has a natural enemy known as *Pteromalus puparum*, a fly-like creature. It is also parasitized by what is known as Apanteles glomeratus. The natural enemy of the cucumber beetles is the *Celatoria diabiotical*, a small fly-like creature which grows as a maggot within the body of the beetle, and kills it when it issues.

More than thirty species of insects prey upon the potato beetle, the *Lebia grandis*, being one of the most important.

Beneficial Insects

Beneficial insects have been touched upon in the preceding topic, and may be properly divided into two classes—those which feed externally upon their prey, and those which live in the bodies of their hosts.

The lady bug is perhaps of the most valuable of predaceous insects. They are especially valuable in destroying aphids, and scale insects. They also devour numerous forms of soft-bodied larvae.

The fiery ground beetle, as well as several other forms of ground beetles, live at the expense of the larvae of other beetles, cut worms, and various forms of caterpillars. The Lebia is a good example of this, in that it follows the Colorado beetle everywhere, and does much to limit its numbers. *Soldier bugs* live off moths and soft larvae. *Robber flies, spiders, daddy-long-legs,* and *syrphus* are among the insects which feed off of other insects. The latter are especially useful in destroying aphids. Mites and wasps may also be considered in the list of insects which prey upon other insects.

The parasite enemies of insects cannot be reckoned upon as of special value in ridding one's garden of noxious insects, because too often they are too slow in action to prevent immediate damage being done to one's garden, but they are useful in preventing insects from increasing to damage crops in future years.

It is in the Hymenoptera family that such creatures are most often found. They are usually dainty and wasp-like.

The chalcis fly, the braconids, the egg parasites, and the ichneumon flies are of this type. So useful did the Apanteles glomeratus prove in combatting the cabbage worm that in 1883 the United States Government introduced it into this country. It has since proved very effective.

Probably the most valuable ally the farmer has in fighting insects are the *birds.* They may be divided into three classes: first those that are entirely, or prefer to be, carniverous, that is that feed upon animal food, such as insects in their various stages. The robin, thrush, kinglet, black-billed cuckoo, blue bird, scarlet tanager, pewees, bobolink, and woodpeckers are among this class. The second class include those that eat both animal and vegetable matter. These are the cat bird, brown thrush, chipping sparrow, marsh robin, white-bellied nut-hatch, and purple grackle. The third class are those that prefer a vegetable or seed diet are the thistle bird, finches, and the indigo bird.

The young of birds require a great amount of food, and most of them are fed on insects. By keeping a careful check on two sparrows, it was found they carried over 3000 caterpillars to their nest in one week. A young robin was fed sixty eathworms in one day, while the owner of a pair of young European jays says they were fed a half million caterpillars in a single season. With such appetites as these to cater to, is it any wonder the *farmer feels he should protect the birds at any cost?*

BENEFICIAL INSECTS

Those of Commercial Value: Bees, Silk Worm.

After the study we have made of injurious insects we are apt to think of all insects as pests. This is far from true. The census of 1910 shows that bees produced $10,000,000 of honey and $2,000,000 worth of wax in that year. But this was about only one-half of the total amount for most of the bees are kept in small swarms by farmers who gave no accounting of the honey or wax they received. $25,000,000 would perhaps be a nearer true total. It is estimated that at least 1,000,000 people in the United States keep bees, and probably 5,000 who make of it a life work.

Yet we must not judge the value of the bee to the farmer only by the amount of wax and honey it produces. The bee is the chief agent for the pollination of fruit trees and certain farm crops. Without bees, there would be less fruit and that of an inferior quality. A famous apple grower in New Jersey says he has fifty colonies of bees and is adding to them all the time for he'd as soon be without a spray pump as a bee hive. Every man who makes fruit growing a business, acknowledges the value of bees in his work. Even the cranberry growers of Cape Cod, Massachusetts have discovered the value of bees and are putting bees among their vines. Viewed from this standpoint, bees perhaps add a great deal more to the weather of our nation than we at first give them credit for doing. The subject of bee raising is too complicated to be gone into here, but it is possible and profitable for every farmer to have a few hives of bees at little cost or trouble to himself. The industrious little fellows more than pay for their keep in honey alone, without considering the service they render fruit and crops.

Our principal source of silk is from the mulberry feeding moth. It is a moth of ashy white color with a body about one-half inch in length, the female being somewhat larger than the male. The larva is hairless, ashy grey or cream in color. The

female lays about 500 eggs, then dies. These eggs hatch and form the larvae which in turn pass into the pupa state. The larvae spin the cocoons with which they inclose themselves. This is the silk of commerce, and when unwound the average cocoon will consist of a silk tread 800 to 1200 yards long. These threads or filiments are later spun into the silk thread of commerce. About two or three weeks after the cocoon is formed, the pupa form is ready to emerge. If it does, the silk is ruined, and to prevent this the cocoons are put into boiling hot water to kill the pupa. If the pupa is allowed to live and emerge, it lays the eggs which form the larvae. The silk worm in the larvae stage lives on the leaves of the mulberry tree. It like the bee, is an insect very helpful to man.

Insects that Destroy Pests; Lady-Bug, Beetles, Dragon Flies, Etc.

The *lady bug* or *lady bird* as it is sometimes called is of service to man. The most common species is red and has thirteen spots on its back. The larvae of the lady bug feed upon the scale forms of insects that are found on our forests and fruit trees. Its family name is coccinellidae, or lady beetles. The adults are short, oval, with underside flattened. The larvae are very voracious and feed upon insects. They prey upon the Colorado potato beetle, and other pests. The lady bugs are among the most beneficial insects to man. Indeed so beneficial are they that they were imported into California to combat the San Jose Scale, and almost destroyed the cottony cushion scale. The nine-spotted lady bug feeds upon plant lice. It is about ¼ inch long. It has a black head and body and orange wings with nine black spots on them.

The two spotted ladybird is also common. It is smaller and has but one black spot on each wing. These beetles help keep the lice from melon vines, also the aphis from peach trees. The spotted ladybird is dark pink with black spots on the thorax and ten on the wing covers. It is often found on corn. The ladybirds which feed upon scales are usually smaller and are black, sometimes spotted. Under no circumstances should they ever be killed.

The *dragon fly* sometimes called *snake feeder* or *snake doctor* also does his part in ridding our gardens of insects. He feeds upon the mosquito for the most part, and in the early evening may be seen darting here and there after them. The larvae are aquatic and distinctly predaceous, feeding on aquatic animals.

The adults catch insects in flight. The eggs are laid close to the water's edge, or even under the surface of the water. After passing the larvae stage they crawl out of the water, the

nymphal case splits along the center line of the back, and the adult fly emerges. Their wings expand gradually and in about one-half hour they fly. They have various names, being known as mosquito hawks, snake feeders, snake doctors, and the Devil's darning needle. They are regarded now as a very useful insect.

Parasites; Braconids, Ichneumons; Protection of Beneficial Insects

There are still other forms of life which help man destroy his pests. These are *parasites,* and live within or on the body of their victims. Many such live on the destructive larvae. The Ichneumon fly, a wasp like creature which varies from a fraction of an inch to an inch or two in length, is of this sort. Some lay their eggs in the body of the larvae. Others lay their eggs near the larvae, and when they hatch the young feed upon the worm.

The Tachinid fly is another interesting insect that helps hold many of the shade tree pests in check. The syrphus fly lays its eggs near the larvae of plant lice and does much to hold it in check. The ichneumon fly has a boring apparatus at the hind end of the abdomen. This it uses to fasten its eggs in the body of its victim.

The tomato worm is one of the pests destroyed by parasites. The eggs are laid in the body of the worm, and then when the grubs or larvae gnaw their way to the surface the tomato worm is killed.

The Proctotrupidae are largely egg parasites, that is they lay their eggs in the eggs of other animals and when they hatch destroy their host. The tent caterpillar is held in check by the ichneumonida. It lays its eggs in the cocoon of the host and its larvae develop in the pupa, which dies when the parasite eggs hatch.

The Braconidae parasitize the plant lice, while the species Apanteles glomeratus is a parasite of the common cabbage worm.

About all that we can say in regard to the protection of beneficient insects is that we should not deliberately destroy them. Occasionally the attempt has been made to import artificially parasitic forms of pest destroyers. It has been successful in but few cases. Weather conditions—moisture, heat, cold, and various other factors enter so largely into the success of such an undertaking that it is an uncertain venture. The Bureau of Entomology of the United States Department of Agriculture is undertaking such a project in its fight upon the gypsy moth. At least ten or twelve species must be introduced and colonized successfully to make the work a thorough success, but since no other means of combatting the moth is known, it will be worth the time and trouble ultimately.

Project

1. Make an insect case or vivarium.
2. If practicable make a collection of insect pests. Use cyanide jar or gasoline to kill insects.

FRUITS AND FRUIT TREES

Fruit Trees of District, Imported Fruits

One of the most valuable crops of the United States is the fruit crop, and of this crop the apple is easily the leader.

Among the fruits common to this region are: apple, peach, pear, plum, cherry, apricot, quince, blackberries, dewberries, raspberries, strawberries, mulberries, grapes, currents, and many others. Such fruits as lemons, oranges, grape fruit, and many others are so well known and universally used in this district that it is with an effort that we look on them as imported rather than local fruits.

The Apple—Parts, Relation of Fruit to Flower

The apple is one of the most common fruits of this region. It consists mainly of three parts, skin, meat, and core, the latter containing the seeds. The fruit is the calyx of the flower developed.

Along with the pear and quince the apple is classed as a pome fruit. The flesh of the pome fruit is the enlarged calyx tube, which unites with the ovary or core, and the edible part of the pome is the developed calyx.

History of the Apple.

No one knows for sure whence came the apple. Our first recorded history shows that apples were then a common fruit. Apple trees are found wild both in North America and in Europe. Experts think that the apple tree however, is a native of the region around the Caspian Sea, and Southeast Europe Even before the Ayrian migrations; it had probably spread westward. But in the West, especially China and Japan it has been cultivated but recently. It seems to have followed the course of western civilization. The early fruit was perhaps crude compared to the apple we know today. It was early cultivated by the Indians, for some of the orchards of the Five Nations Indians remain in New York State at the present time. These were seedlings said to have been raised from the seeds of apples missionaries took into the interior with them. As early as 1639 apples were picked from trees planted in Boston harbor on Governor's Island. Governor John Endicott of Massachusetts Colony had his apple orchard and in 1644 five hundred of his trees were destroyed by fire.

But the early apple was grown for drinking rather than eating as the enormous amount of cider made in those days shows.

In 1753 began the modern accurate naming of plants, the apple then was called Pyrus Malus. Pyrus is the group name for pears, apples and quinces, while Malus is the Latin name for apple.

Varieties of Apples; Summer, Fall and Winter Varieties.

There are many varieties grown in this region. Among the early summer apples are: Yellow Transparent, Leveland Raspberry, Early Harvest, Red June, Early Ripe, Henry Clay, and Williams Eary Red. Among the summer apples are Stark, Summer Queen, Duchess, Yellow Horse, Maiden Blush, and Wilson Red June. Fall apples are: Patten Greening, Fall Pippin, Rambo, Wolf River, and Wealthy. The early winter varieties include Tolman Sweet, Roman Stem, R. I. Greening, Wagener, and Fameuse. Among winter apples we find the Northern Spy, Baldwin, Smoke House, Banana, Belleflower, (Yellow), Grimes Golden, Jonathan, Stark King David, Roman Beauty, Golden Winesap, Paradise Winter Sweet, and many others. Among the later winter apples are York Imperial, White Pippin, Jeniton, Champion, Stark, Winesap, Willow Twig, Stark Delicious, and Black Ben Davis, besides others too numerous to name.

Picking, Storing and Marketing Apples

One of the chief reasons of a great deal of waste on farms of fruit is because fruit picking time comes when the farmer is busy with other farm fall duties. For this reason, much of the fruit is left to careless pickers, or not gathered at all. If intended for winter keeping or shipment, fruit should be hand picked, then packed in boxes or barrels, if for shipment. Some fruit growers use much care in their boxing of fruit, and consequently receive fancy market prices. If stored for winter keeping, apples and other fruits should be placed in cold but not freezing, dark, well ventilated bins. Sorting should be done at the time of picking and usually should be done in four lots. The first will include only the sound, perfect fruits, usually intended for fancy packing and fine marketing. The second will include sound, but imperfectly shaped fruit. The third class will be the seconds, usually used for immediate cooking, and the fourth will be the culls, usually refuse fruit. The question of market varies in different localities. The average farmer will usually find a ready market near his home, while fruit growers who have fruit in quantities usually ship to commission men in the large cities.

Storing in the Home for Winter Use

For home use, apples may be stored in boxes in a cool, moist cellar. If intended for late keeping the temperature should be 40° F. or lower.

In a cellar where there is a furnace or in a warm attic the fruit is liable to shrivel because the air is too dry. If necessary to use such a storage place, wrap each apple in paper and keep in a closed barrel. The fruit must be sorted now and then, unless the trees have been most carefully sprayed and the fruit very carefully picked and graded. Such care is not necessary in cold storage. An outside cellar if properly ventilated is a good storage place.

In cramped city quarters, the question of home storage is a more serious one, and usually it is not desirable to undertake to store more than will meet immediate needs.

Apple Growing Regions

Central Europe, Canada, and the United States are the homes of the apple. However, apple culture is beginning in New Zealand and parts of Australia. They are beginning to export to the continent of Europe and the trade promises to increase, especially with South America. In Europe, the trees are more carefully pruned and cared for than in most parts of the United States. Here we usually let the tree assume what shape it will, and do not prune for the development of fruiting wood.

The apple regions of North America are in southern Canada and the northern part of the United States. This extends southward into the eastern mountain regions.

In Nova Scotia, Prince Edward's Island, and New Brunswick, Ontario, Quebec, and British Columbia, we find the chief Canadian apple orchards.

In the eastern United States it is found in the Hudson Valley, western New York, New England Baldwin belt, New Jersey, Delaware, Shenandoah-Cumberland district, in Virginia, some regions of Pennsylvania and West Virginia, and the mountain regions of Georgia. Further west, we find it in some parts of Ohio, Kentucky, and Michigan. In Illinois we find it in the southern Illinois apple region and the Mississippi Valley region of Illinois.

Apples are also found in the Ozark region, the Arkansas Valley of Kansas, Colorado, New Mexico, Utah, Montana, certain districts of Washington as the Yakuma Valley, Wenatchee, north central Washington district, Spokane and Walla Walla districts.

In Oregon the apple districts are in the Hood River Valley, Rogue River Valley and other districts.

In Idaho the apple districts are:—Payette, Boise Valley, Twinfalls, and Lewiston.

California, Wisconsin, and Minnesota also produce apples to some extent.

Comparative Study of Other Fruits Pear, Quince, Peach, Plum

The pear is not as extensively grown as the apple, but is a paying crop if well cared for. It grows best in deep rich loam, in full exposure to light and air. Pears are more subject to inroads from pests and diseases than the apple, therefore require more attention. Trees two years old are best for planting and are planted the same as the apple. The same care in fertilizing and prunning are necessary. Trees are planted twenty to twenty-five feet apart. Many pears are grafted upon quince stock, and may be grown as dwarfs instead of standard.

The pears most generally grown are: Summer, Bartlett, Clapp, Giffard, Autumn, Seckel, Bosc, Kieffer, Winter, Hovey, and Lawrence.

Pears should be picked while still hard but fully grown, just when the color begins to change. Then they should be placed in a cool, close, dark place, in trays one layer deep and covered with a wool blanket. Sometimes they are sold from cold storage in boxes, or one-half barrel casks.

The San Jose scale and the pear psylla are especially injurious to pear trees. Lime and sulphur spray checks the former. The pear tree psylla is a minute brown aphis like insect which flies about the trees in early spring and lays its eggs on the leaves and tender twigs. From the eggs a flat aphis hatches which feed upon the tree juices. Lime and sulphur are recommended but no satisfactory control has been found.

Leaf blight and fire blight are two diseases destructive to pears. The former may be controlled by Bordeaux mixture, using just before the leaves open, just after the petals drop, and twice more at two weeks intervals.

The fire blight is a bacterial disease much like smallpox in the human body. It is more apt to prove troublesome in hot, damp weather. If the trees are attacked, the diseased branches should be cut away at once, or the whole tree will die in a few days. Lime and sulphur spray is recommended as well as the Bordeaux mixture.

The *quince* has not grown in demand as has other fruits. It is used only in a cooked state and largely for flavoring other less tasty fruits. To grow it successfully a deep rich strong soil is necessary. It grows best near cesspools or poultry yards. Strong

two year old trees should be planted. This may be grown from cuttings or grafted upon apple roots. They should be pruned much as the apple or pear. They should not be planted in turf, but require frequent cultivation.

The quince may be pruned to the tree or bush form, the latter being better for the amature fruit grower, as it is more easily sprayed and cared for. When three to five years old the tree should begin to bear, and with care are long lived. Uncared for they are short lived. The Orange, Rhea's and Champion are the chief varieties. The Orange is the more common but the Rhea's is larger. They are usually sold in one-half peck baskets and keep well for shipment, if carefully packed. For retail trade loose packing is recommended. The diseases and insects which attack the apple and pear are common to the quince. The remedies are the same.

The peach may be profitably grown in many parts of the United States from Canada to Georgia. The peach grows best in a thin soil on elevated land with full exposure. The land should be prepared by deep plowing under of green crops and by harrowing before the trees are set. Trees should be selected for planting from the same region where they are to be grown. Trees of medium or small size should be selected. The tree may be trimmed back to a single cane, others trim it back to within two or three inches of the bud. At the end of the first season there should be a conical formed tree with three or four main branches, starting one to three feet from the ground. When they begin bearing the years that the buds are winter killed should be selected for pruning time. All wounds more than one inch across should be brushed with linseed oil. Peach orchards if well cared for last ten to twelve years. In the north the peach averages three crops out of five years.

To be of best quality the peach must ripen upon the trees, therefore it requires great care in handling.

New varieties of peaches appear every year but the standards are: Champion, Mountain Rose, Crawford's Early, Crawford's Late, Alberta, and Fitzgerald.

The San Jose scale and peach borer are its two greatest enemies. The later is a small wasp like moth with transparent wings. Its eggs are laid on the trunk near the ground. It may be recognized by the masses of gum which exude from the bark, and with a knife one may dig out the fat white larvae.

Peach curl and peach yellows are two funguous diseases. Lime and sulphur are recommended for both but is not a sure remedy for the yellows. If badly affected with the latter, the trees had best be removed, for they never entirely recover from it. Fertilizers containing large amounts of potash and phosphoric

acid should be used in young orchards and cultivation made deep.

There are three varieties of *plums* common in the United States. They are the European, Japanese, and American. The first include the blue plums, Lombards, Damson, etc. The Japanese include the Burbank, Abundance and Wickson, with the Climax and October Purple. The American plums grows wild. Among the best varieties are the Weaver, Hawkeye, Wayland, Wild Goose, Moreman, and Reed.

For most varieties a strong, moist but well drained soil is essential. The trees must have a good circulation of air and sunshine. Strong one year old trees budded upon native stock give the best results. They are pruned and planted in the same way as the apple. Clean cultivation is essential. Potash and phosphoric acid make good fertilizers. The European varieties are less hardy than the American and require much care. They are attacked by the peach borer, and the plum curculio. The latter attacks the skin, makes a crescent cut in it, and here lays its eggs. The larvae hatch, feed on the fruit, cause it to fall, then the larvae enter the ground where they remain till next year. Spraying with Bordeaux mixture and paris green as for the codling moth is recommended, just before the flowers open, after they have fallen, and twice after at two week intervals.

Three diseases destructive to plums are black knot, leaf blight and brown fruit rot. Black knot may be checked by pruning the affected parts. Spraying as for the plum curculio is recommended, but all trees in the region must be sprayed to make this effective.

The brown fruit rot is a fungus disease that attacks the mature fruit, causing it to rot, and covers it with grey dust like spores. Bordeaux mixture is recommended.

The Japanese plum bears in three to five years, but is not quite hardy. It is often propagated upon peach or native plum stocks.

The American plum is hardy and is being crossed with the European and Japanese to secure size and flavor. It is sometimes attacked by the peach borer or leaf curl. Dilute Bordeaux mixture is recommended (4 copper sulphate, 6 lime, and 100 gallons of water).

Propagation of Fruit Trees

If we plant the seeds of many plants, the resulting plant will be like the parent, but this does not hold good among fruit trees. Seeds planted result in what are known as seedlings, and the fruit from it will be small and of an inferior quality. But in order to secure fruit such as we wish, we may resort to grafting. This means bringing the cambium layer of a vigorously growing

seedling into contact with the cambium layer in a stem of a similar kind of tree. After fitting the parts closely together, bind them with cotton yarn which has been coated with grafting wax. Smear the wax thoroughly over the whole joint to make sure that it is air tight. Do your grafting in February, and put your grafted tree in damp sand until you are ready to set it out.

Thus, if we wish a Grimes Golden apple, we can take a branch from a Grimes Golden tree, graft it onto the seedling of any apple, and the resulting tree will bear Grimes Golden apples such as the parent tree bore, from which the cutting was made. In this way, many improvements have been made in our present day fruit trees.

Seeds, Seedlings, Grafting, Different Methods, Why Necessary

In general, apple trees raised from seeds bear little resemblance to the apple from which the seeds were taken. Trees so raised are known as seedlings and the fruit of such are usually very inferior in size and quality. However, some seeds if inbred, may produce apples identical with the mother tree, and such are called reproductions of the mother variety. The only reason that apples and other orchard fruits do not come true to seed is because it has not been found necessary to fix the type by a long period of selection as has been done in certain flowers. Grafting settles the question much quicker and easier.

Grafting in most cases help us to reproduce any given variety of the apple. There is little difference between budding and grafting. The former consists in inserting but one bud into the growing plant, while grafting consists of inserting a branch with several buds. The stock is the growing plant, the cion or scion is the inserted plant. Most dicotyledonous plants as apples, legumes, evergreens, cacti, and members of the potato family have been grafted. Monocotyledenous plants such as grasses, lilies, etc., have never been successfully grafted.

There are so many ways of grafting it is not practical to enter upon a discussion of them here. They are: Whip or tongue grafting, root, cleft, veneer, side, splice, saddle, bridge, crown, and terminal bud grafting. If interested in any of the kinds, government bulletins may be obtained describing each fully.

Grafting may be necessary:— 1st To change the character of the plant by modifying the wood, leaves, or fruit.

2nd. To bring together two sexes of monolcious plants in the same trees in order that fruit may be produced.

3rd. To restore an old or worn out tree by infusing new sap and new wood.

4th. To produce flowers, fruit and branches on parts of trees which lack them.

5th. To propagate many plants which can be reproduced in no other way.

(See earlier work for grafting and budding.)

List of Trees Propagated by Budding

1. Rose
2. Pear
3. Apple
4. Plum
5. Cherry
6. Quince
7. Peach

Care of Fruit Trees

For orchard, the average farmer will usually work out his own scheme of caring for his trees. Whatever plan is followed, it must include replacing trees that have served their day of usefulness, also replacing unprofitable trees, cultivating the young trees, spraying for various diseases and insects, and in general building up and keeping in good shape, the plot of ground he has set aside for his fruit trees.

The Orchard, Soil, Cultivation, Planting Distances; Pruning, Why Necessary; Time to Prune, Method of Pruning

Many farmers are now awakening to the value of good orchards, and a general revival of interest in fruits and fruit culture seems to be eminent. It has been proved that one vigorous bearing fruit tree will yield more cash profit than an acre of hay, two will yield more than an acre of corn, and three more than an acre of potatoes. When farmers wake to these facts, they will not begrudge the land given over to orchards. The planting of a young orchard is very important. Spring is the best time. The roots of the young tree should be pruned carefully. A hole large enough to admit the roots without cramping should be dug. The tree should be put two or three inches deeper than the former soil line on the stock.

Trees may be planted about one hundred to the acre. When the young tree is first set out, if the season is dry, frequent watering may be necessary. Judicious pruning is necessary to secure good strong sturdy, well shaped trees. Pruning should be done just above a leaf bud, pointing out from the tree. The second season, trees should be pruned lightly to secure a good root system.

A young orchard requires more or less cultivation. Around each tree, the earth should be kept mulched, to prevent to rapid evaporation of moisture. While trees are small some farmers sow small grains or grasses between their young trees. Farmers

who wish to secure good sturdy trees must be on the lookout for various insects and diseases that often attack young trees.

In discussing the various fruits we have mentioned the different kinds of soil best suited to each kind. It varies from the clay loam or the strong moist loam required for the apple to the thin light required for the peach. Most fruits do not like wet feet, hence the land should be well drained. Wet soil invites various diseases.

Pruning has also been discussed at some length. In general it may be said that all trees require pruning if the best fruit is to be obtained. Yet if not done wisely great damage may be done.

Trees should not be planted so close that heavy pruning is necessary. When trees are planted but 20 or 25 feet apart, it may be best to cut half of them out, prune from the top and force out new growth from lower levels.

Do not cut off all the sprouts inside the tree. If a few of these are allowed to grow each year, a new head is soon formed and the old wood may be cut out. The time of pruning varies under different conditions. The young tree should be pruned when first set out, or if the buds are winter killed, that year may be a good time if heavy pruning seems necessary. Pruning may be done at any time if the tree shows a diseased condition and the need warants drastic measures. Usually the early spring is the best time for general pruning work, six or eight weeks before growth is resumed.

The methods of pruning depend wholly upon the result desired, and may vary from merely rubbing off buds and sprouts with the open hand, to removing heavy wood with saws and pruning hooks. Pruning shears are best used on young trees. All large cuts should be painted over with linseed oil.

Insect Enemies of Fruit Trees

A partial discussion of insect enemies has been made under the various kinds of fruit.

In general there are two kinds—those that attack the fruit and those that harm the tree or foliage. In the apple tree pests we find the *codling moth, fruit miner, maggot, curculio* and *weevil* which attack the fruit. The *bud moth, click, beetle, leaf roller, canker worm, measuring worm, tussock moth, webworm, tent caterpillar, gipsy moth,* various forms *of aphis, scales* and *leaf hoppers* attack the tree or foliage. There are also various kind of *borers, flea beetles, mites, tree bugs, weevils* and *crickets* that also are harmful.

Pear and Quince pests include *slugs, pear psylla, thrips, mites, borers, beetles,* and *scales.*

Plum pests are the *curculio, gouger, borer, sawfly, beetles, louse, aphis, scales* and many others.

Peach pests include *beetles, worms, sawflies, scales, aphis* and others.

Funguous Diseases; Spraying.

A fungus is one of the lower order of plant life. It differs from plants of the higher order by having no flowers, and by producing no chlorophyll which gives the green coloring matter to leaves. Its seeds are known as spores, and its roots which are very fine filiaments are known as spawn. It is the mycelium which damages trees it attacks. These make their way through the woods and break down the cells and thus destroy the plant. The seeds or spores are very tiny. There are two types of fungi—those which attack living plants and are called parasites, and those which live off dead matter called saprophytes. Moulds and mildews are fungi but differ from the greater number of fungi by not penetrating into the host but by merely living mainly on the surface of the host.

Fungi form two kinds of spores—summer and winter, and spraying depends upon which spore one wishes to kill. To kill summer spores one must spray at the very first sign of the disease. However, the disease may often be merely checked and repeated spraying may be necessary.

Besides spraying in winter, one must burn all dead leaves, shriveled fruit, and pruned branches. All wounds should be painted or tarred over, for wounds even very minute are the means of access to the tree for the fungi.

Among the most important fungus diseases may be mentioned the *apple scab, black rot* and *mildew* of the grape, *fruit rot* of the peach, *leaf blight* of the pear and plum, and *black knot* of the plum.

The presence of these diseases is shown by spots, discolorations or excrescences scattered over the surface of the leaves, branches or tree. If the fruit or leaves are attacked they usually drop from the parent tree. The fungus diseases are especially hard to control because once the spores are embedded in the fiber of the branch or tree the wood itself must be destroyed in order to destroy the fungus. Bordeaux mixture or lime sulphur spray is recommended. The first spray should be used just as the buds are well developed but before they have opened into the flower.

Among apple growers, the fungus diseases most dreaded are the *bitter rot, cedar rust,* and *apple blotch.*

The *bitter rot* winters in old wounds on the branches of trees, and as the spores are ripened late in the season, it attacks

the mature fruit. Bordeaux mixture spraying is good, also all old wood should be cut out. Black rot is similar to bitter rot and should be treated accordingly.

Cedar rust lives in two different hosts during its life cycle. One season it causes excrescences known as cedar apples on the red cedar tree. The next year spores develop from these which in turn go back into the apple orchard. It causes a peculiar orange colored spot on the foliage. The leaves so affected fall until the tree may become quite bare. The best cure for this is to remove all cedar trees from close proximity to apple orchards. If this isn't possible spray with Bordeaux mixture.

Apple blotch causes brown markings on the fruits, and passes the winter as brown cankers on the twigs. Lime sulphur solution diluted one to five used in the winter is recommended.

The lime-sulphur is a commercial solution put out by manufacturers. It is recommended that it be used one to eight but experience has shown one to five to be better, and reduces the need for more frequent sprayings.

A mixture of barium and sulphur has lately been put out that promises to take the place of the lime sulphur. It does not affect the appearance of the fruit as does the latter or Bordeaux mixture. However, there seems to be no better general fungicide than Bordeaux mixture. However it is apt to cause a russeting of the skin of fruit as well as to burn the leaves of the tree. Lime-sulphur solutions are superior for this reason.

Following are a few of the formulas for well known insect and fungi sprays.

BORDEAUX MIXTURE.

Copper sulphate (blue stone or blue vitriol) 4 pounds.
Fresh lump lime 4 pounds.
Water 50 gallons.

SODA BORDEAUX MIXTURE.

Copper sulphate 4 pounds.
Caustic soda (soda lye) 1 to 1½ pounds.
Water 50 gallons.

AMMONIACAL COPPER CARBONATE.

Copper carbonate 5 ounces.
Ammonia, 26 degrees Baume, 3 pints.
Water 50 gallons.

POTASSIUM SULPHIDE.

Potassium sulphide 3 ounces.
Water 10 gallons.

Dissolve and it is ready to use. Used especially for powdery mildew on gooseberries.

Self Boiled Lime Sulphur.

Fresh stone lime 8 lbs.
Sulphur 8 pounds.
Water 50 gallons.
Used for peach scab and Brown rot.

Crown Gall is due to an organism that usually attacks the Rosaceae family. No cure is known for it, and plants so infested should be destroyed. It manifests itself as swellings which form on the roots or crowns of trees. These increase in size rapidly, last for one season, decay, and reappear again next year.

Root rot usually appears in orchards planted in newly cut over timber land where oaks have grown. To prevent, do not plant such land as orchards for several years after clearing.

Apple scab is found in most orchards. It attacks fruit and leaves, where it causes large dark velvety black patches. It seems to be aggrevated by a late cold, wet spring.

Among the cherry trees we have *Black knot, Leaf Spot,* and *Powdery Mildew* the chief fungi diseases.

Currants suffer from *Anthracnose* and *Cane Blight.*

Among Blackberries and *Raspberries* we find *Anthracnose, Cane Blight, Crown Gall,* and *Orange Rust.*

On the *grape* we find *Anthracnose, Black Rot, Downy Mildew,* and *Powdery Mildew.*

Peaches suffer from *Peach Blight, Brown Rot* (especially destructive), *Frosty Mildew, Leaf Curl,* and *Peach Scab.* The *Brown Rot* may be held in check by spraying with the lime-sulphur mixture and lead arsenate—two pounds of the lead arsenate to 50 gallons of the mixture. Should be applied about three times.

Pear Blight is one of the chief pear fungi diseases.

Plum Pockets (much like leaf curl) of plum trees, and *Leaf Spot on Strawberry vines.* The latter attacks the leaves of strawberry vines, first as a purplish spot, later greyish in color, with red margins. If much affected the whole leaf may turn red. Plants should be sprayed before flowering and after the fruit has gone with Bordeaux mixture.

Projects

1. Plan to care for the home orchard or at least two or three trees.
2. Collect pictures of different varieties of apples and other fruits and mount in your booklet.

SECOND QUARTER

HARD WOOD CUTTINGS; DOMESTIC ANIMALS; WATER SUPPLY

Some plants, as we know are reproduced from seeds. This is true of most of our flowers and vegetables. Others are propagated by grafting or budding as our apple, pear, or plum trees. Others are reproduced by means of *hard wood cuttings.* This class includes grapes, gooseberries, and currants. Blackberries are propagated by shoots from the old plants, as are red raspberries, while black raspberry plants reproduce themselves by the tips of the new canes touching the ground and taking root. Strawberries are reproduced by runners.

The grape is perhaps the easiest propagated of any of our fruits. If a new vine touches the ground and is so allowed to remain during the growing season, the chances are roots will develop at the joint, and if cut back to these roots, a new plant is the result which may be transplanted elsewhere.

This characteristic of the grape vine is taken advantage of by nurserymen, to propagate new stock, and most of our grapes are obtained by what is known as hard wood cuttings. *Such cuttings must be made in the winter or late fall when the plant is dormant—that is, not growing.* Often cuttings are made in the fall and are kept in a cool moist place till spring when they are planted in rows. Such cuttings consist of a section of the wood of the last season's growth with a joint and bud at each end. When the cutting is made, it is placed with the top bud just at the ground line. The roots will form from the joint placed underground while the vine will grow from the protruding bud.

Grape Vine, Stem, Tendrils, Buds

The stem of the grape vine is too well known to need any lengthy discussion. We are all familiar with the long, smooth stems, covered with spines, hairs, or long pieces of loosened bark. These are of great interest to the pomologist, for they help him determine the species of grape, but to the average student the leaves, tendrils and buds are the most important.

The leaves are of special importance because upon them depend the growth of the vine and fruit. Beyond a certain point if we diminish the number of leaves we check the vine's growth.

This does not mean, however, that the leaves should not be removed. Occasionally the growth of leaves is so heavy, too much shade for the fruit and vine is made, hence, it is necessary to cut back some of the leaves. The grape under cultivation seems to produce a greater amount of foliage than is necessary for its proper growth hence such thinning out is frequently necessary.

In general grape leaves are heart shaped. The edges of the blade are notched. When these notched are small the leaf is spoken of as dentated or toothed. When the divisions are irregular and sharp it is called cut-toothed.

All grape leaves while growing are green, but no two varieties possess the same shape. Most are divided into three more or less regular lobes. Sometimes the veins and petrole are red, while this color sometimes extends over much of the leaf, others are dark brown.

The tendrils are an elongation of the wood fiber of the stem. While green and tender they are straight, slightly bent at the end, but as the fiber hardens, they draw up into curling masses. These tendrils are of great help in enabling the grape to raise itself up from the shaded dark places below into the light and air where its fruit may mature. These tendrils live but the one season, but are not like the leaves, shed in the fall or winter. They are always placed just opposite a leaf. While of great use to the wild grape, tendrils are worse than useless to the cultivated vine, and should be removed to keep the vines from becoming entangled.

The first three or four tendrils borne by the stalk in the spring are but the peduncles or flower stalks of the thyrse of flowers which later develop into a bunch of grapes. If they do not develop into flowers because of lack of heat, light, etc., they become tendrils. Hence we can say that a tendril is a barren peduncle or a bunch of fruit a productive tendril. Hence, we can see the importance of the tendril to the whole plant.

Buds are embryo plants, for in them are all the elements necessary, if removed from the parent plant, to reproduce a separate distinctive grape plant. They contain stems and leaves in rudimentary form. The buds are never found upon any other part of the stem than upon the axils of the leaves. In a wild state, these buds never produce but one shoot, but in the cultivated grape, a number of shoots may be produced from a bud. But if one wishes to produce a strong growth, one vine alone from a single bud is best.

All main buds should be fully developed, especially those required for producing fruit because it is only from such buds that the best canes and fruits are produced.

Nature has tried to protect the bud with bud scales which serve to shield the tender bud from the cold of winter. In most localities where grapes are grown, this covering is sufficient. In others, it is necessary to furnish some artificial protection. The disk has five thick glands or lobes which alternate with the stamens, between them and the base of the ovary. The flowers have a fragrance much like that of mignonette.

Choose Some Good Variety and Make Cuttings

Perhaps no plant can be more easily propagated by the amateur than the grape. Hence the students should make cuttings and note their growth. If more ambitious, they may try grafting one kind upon another. Many pomologists insist that this is the only way to secure a high grade standard grape. The cuttings are made, grown from the bud, and upon this root stalk grafts are made. These grafts are less complicated than those on trees and may be performed very easily by the average careful student.

Gooseberries and currants are also reproduced by hard wood cuttings. It will be interesting and profitable if the teacher will have students prepare cuttings of these and have them planted in a corner of the school ground. Most small town schools and every country school could have its own experimental station where actual laboratory work could be done. Its value to the school is incalcuable.

Project

1. Plan to grow and care for the grape plant.

FARM ANIMALS OF THE COMMUNITY

List of Animals Raised in the District

Perhaps the chief place of all domestic animals may be given to the horse. To this animal, the cow is a close second. Pigs and sheep are also of great importance. Among fowls, the chicken ranks first, while ducks, geese, and turkeys are also found in almost every barn yard. Pigeons, guineas and various other fowls are usually kept as pets or as curiosities rather than as an important part of farm life. Bees are found on many farms, where fields of clover furnish them abundant honey materials. Dogs are no longer the necessary animal on farms they once were, when large flocks of sheep ranged over the open prairies. Yet there are few farms without a dog and often several cats. Last, but not least, come the birds, which abound in farm orchards. That they are, for the most part, true friends to the farmer is fast being recognized throughout the land. These various animals will be discussed at length during the following work.

Animals of Different Breeds

Circumstances and conditions play so great a part in deciding what animals are raised that no definite list can be given. However, among horses we may find the *Arabian, Thoroughbred, American, Saddle, Roadster type, Trotter, Pacer, Coach* or carriage horse type, *Hackney, Draft, Percheron, Clydesdale, Shire, Belgian, Suffolk, Shetland Pony.*

Among the cattle we may mention the *Shorthorns, Hereford, Aberdeen Angus, Galloway, Sussex, West Highland* among the beef. Among the dairy type are: *Jersey, Holstein-Friesian, Guernsey, Ayreshire, Dutch Belled* and *French Canadian.* Among the dual purpose are: *Red Polled, Devon, Brown Swiss.*

Among the sheep we have the *Marino, Rambouillet, Southdown, Shropshire, Oxford Down, Dorset Horn, Cheviot, Tunis, Leicester,* and others.

Approximate Value

Farm animals make use of various farm crops, such as hay, cornstalks, straw, etc., which would be utter waste if they did not eat it. Fully one-third of the total digestible nutrients of the corns crop remains in the stover after the ears are removed. These feeds, eaten by cattle, sheep, and hogs, are converted into milk, meat, wool and leather through the agency of the farm animals. Another phase of this same advantage is that these food products may be fed, and the resulting food and clothing transported at less cost and in less space, where they are needed, than the originals could have been. Perhaps one of the most direct result of keeping farm animals is the fact that manures taken from barns and lots where such animals are kept form one of the chief means of land improvement.

We now come to the actual value of farm animals, and products of farm animals. Since the last few years have been so largely influenced by the war, in order that one may have a more definite notion of the value of farm stock in normal times, the following statistics are taken from 1910.

In 1910 there were 20,625,432 dairy cows on regular dairy farms, with 1,170,338 such cows not on regular farms. The total value of the former was $706,236,307, and of the latter $47,000,000.

The total number of all cattle in the United States was over 63,600,000, with a value of over $1,500,000,000. The number of horses was over 23,000,000, valued at more than $2,500,000,000. Number of mules, 4,480,000, valued at $564,766,000. Asses and burros, 122,200; value, $14,901,000. The grand total of mules, horses, asses and burros being 27,618,242, with a value of over $3,085,460,000.

The number of swine for the year 1910 was 59,473,000, with a value of $409,414,568. Sheep numbered 52,838,748, with a value of $234,664,528. Goats, 3,029,795; value, $6,542,000. Making a total valuation of $5,296,421,619.

The average value per head of dairy cows was about $35. The average of all cattle was about $24.50, while that of horses was $108.87; of mules, $126.06; asses and burros, $121.94; pigs, $6.88; sheep, $4.44; goats, $2.16.

In considering the value of farm animals, it is also well to consider the value of their produce as well. Hence, the following table of butter, cheese, and milk may be of interest.

In 1909, 624,764,653 pounds of butter were made in factories and 1,619,415,263 in factories and on farms together. In the same year there was a total of 320,532,181 pounds of cheese made, while the same year, 5,813,699,474 gallons of milk were produced.

In 1910, there were 282,110,164 chickens raised, and 11,027,213 other fowls, making a total of over 488,468 fowls, with a total of 1,591,311,371 dozens of eggs produced. From these figures, imperfect as they may be, we get some idea of the real value in dollars and cents of what our farm animals mean to us. Each farmer may have but a few animals of moderate value, but the grand total throughout the United States makes one that constitutes a real part of our national wealth.

Observational Study of a Cow

Cattle, according to their zoölogical classification, are mammalia, as is also man. Mammalia occupy the highest class among vertebrates—that is, animals with back bones. Any animal which rears its young on its own milk belongs to the mammalia. All mammalia are more or less covered with hair. They also are more intelligent, hence have larger brains in comparison. Breeding has changed the general characteristics of cattle until beef and dairy cattle vary much in general form as well as in color. The greater number of cattle have horns, are covered with hair, which varies from stiff, coarse hair to soft, silky hair, found in some breeds of dairy cattle. The different features will now be discussed separately.

Body Covering of the Cow

A cow has a somewhat heavy skin covered with short hair. Both the texture of skin and hair varies greatly. In beef breeds the hair and skin will often be found much coarser and heavier than in the dairy breeds. On some breeds, the hair is soft, short and smooth, as in the Jersey breed, while on others it is long, with a curly tendency, as in the Hereford breed. However, one must not take for granted because a certain type is a beef type

that its skin and hair is coarse. Take the Angus, for instance. Its skin is soft and pliable, and its hair fine.

The Galloway breed have long, wavy, silky hair, which protect them from the severe winters and make them especially well suited to withstand rigorous climates. As a general rule, the better breed a cow is, and the truer it runs to that breed, the finer and smoother will be its skin and hair.

Sense Organs of the Cow

Perhaps the most noticeable feature of a cow's face is its nose, the shape and color varying in different breeds. It may be smooth and straight, as in the Angus, or slightly enlarged and upturned, as in the Galloway. The nose tip is not covered with hair. The nostrils are large and, in the better breeds, delicately shaped.

The eyes are prominent, usually set wide apart, somewhat at the side of the head. The ears are small, medium, or large, depending on breed, and are opposite or slightly above the line of the eyes. The ears are covered on the outside with hair. The color of the inside is often indicative of breed or personal characteristic of the animal. This is especitlly true of the Jersey.

Feet and Toes of the Cow

The cow is an "ungulata" or hoofed animal. This class of animals is almost always herbivorous, the canines are rarely well developed, the molars numerous, and suited to grinding the food, are more or less flattened, and frequently have folded enamel.

The legs of ungulatæ are exclusively locomotor arrangements, and permit free motion. The clavicles are absent. The feet touch the ground only by the tips of the toes, which are enclosed in hoofs. The cow belongs to the group known as artiodactyla or animals with an even number of toes, while the horse belongs to the Perissadactyla or animals which have the middle toe developed into a hoof. The cow really walks upon her two middle toes, each of which is provided with a hoof. The rudimentary toes at the back are digits which have disappeared as far as their usefulness is concerned.

It would be well if the teacher could secure a skeleton of a cow's leg and show how the metacarpals and metatarsals are greatly elongated, the ankle and wrist being raised from the ground to such a height that they are often confused with elbow and knee. The radius and tibia are becoming more developed at the expense of the fibula, which is becoming rudimentary and the ulna, which is often developed throughout its whole length, other times only in its upper part, and is more or less fused with the radius.

Parts of the Body, Muzzle, Jaw, Face, Forehead, Withers, Shoulders, Loin, Etc.

In considering the body of the cow we must realize that there is a vast difference between the body shape of a milk type and that of the beef type. Also the different breeds of dairy cattle differ much from each other just as do the breeds of beef cattle. Hence the following discussion must be general in so far as it applies to cattle in general.

By the *muzzle* we mean the part that is usually referred to as the nose. It is smooth and hairless.

The *jaw* is located below the eye in front of the throat.

The *face* is the smooth bony ridge above the muzzle and centrally below the eyes.

The *forehead* is the smooth plate between the horns, while the *withers* (dairy cow) is the point on the back above the shoulders between the neck and the back proper.

The *shoulders* are about on a line drawn through the body lengthwise between the throat and ribs.

The *loin* is the small portion of the back between the back proper and the hips. The *rump* is that portion between the hips and pin bones.

The lower part of the body below the ribs and above and in front of the udder is often called the *barrel.* Other parts such as the legs, tail, udder, thigh, etc., are too well known to need describing.

The parts of the dairy cow differ from that of the beef cow in that they include the following:—

The *brisket* is located in front just below the breast. The *dewlap* is also in front near the breast. The *shin* is just above the hoof.

Crops are above the shoulder and ribs. The *hock* is the lower part of the hind quarter. The *shank* is below the hock.

Mouth of the Cow, Method of Feeding

Since the most important part of a cow's mouth is the teeth, they alone will be considered here. As in the case of all domestic animals, the teeth furnish a fairly accurate means of judging the age of a cow.

The calf often has a pair of central milk teeth at birth. There are incisors in the lower jaw only, the upper being provided with a cartilaginous pad. At about eighteen months of age, the permanent teeth replace the milk teeth. These are about two times as broad as the milk teeth, hence are readily recognized. The second pair appear at twenty-seven months of age, the third at thirty-six months, and the fourth at forty-five

months. After this age, the wearing of the teeth is depended on to denote age. After ten years of age, little change takes place. The teeth are adapted to an exclusively herbivorous diet.

Cud, Apartments and Functions of the Stomach of the Cow

Like a cow's teeth, her stomach is adapted to a strictly herbivorous diet. It is divided into two portions, each subdivided. The first is known as the rumen or paunch, and receives the food as it is eaten. Then when the cow is quiet it is regurgitated into the mouth, and chewed by the molars, hence "chewing the cud." Then it passes the second time into the second division, the honeycomb or reticulum, thence to the manyplies, or omasum, and lastly to the abomasum or true stomach.

CATTLE

Cattle—Two Great Classes, Dairy and Beef. Difference in Form Between Dairy and Beef Types of Cattle

Cattle were the first animals domesticated. Some hold that our earliest cattle were domesticated from wild cattle that roamed over Europe and Asia at early times. Others hold that cattle originated in Asia, and were later taken to Europe during the great Aryan migration. The ancients secured no great degree of development. That was left for later centuries. Within the last two hundred years, great attention has been paid to breeding until now there are over three hundred distinct breeds of cattle.

The most valuable breeds have come from Great Britain and northwestern Europe. The two main classes of cattle at the present time are dairy and beef cattle. The dual purpose cattle are those that combine qualities of both beef and dairy types.

There are two distinct types of cattle—first, the dairy type, and second, the beef type. These types are determined by the demands made on the animals. In the dairy type, the udder is the most important organ, but in the beef type, it is important only to rear the young calf. In the beef type, it is necessary that the body be plump and full, and that the animal take on flesh and fat readily. In the dairy type, this quality is a real detriment. Since the dairy type is kept for the milk, it will secrete, and since its food should go to produce milk and not meat and fat, the body will be thin. Since the secretion of milk takes place in the udder, the rear development of the dairy type will be large, and since the milk production depends largely

upon the digestive tract, and therefore a large milk yield calls for a large digestive tract, this will add to the rear development.

Fleshiness is always objectionable in the dairy type, and while the general outline may vary, the following is typical. In general appearance, a dairy cow resembles a triple wedge. A side view shows greater width of body behind than in front. From the rear and top, she gradually widens from the chest to the hips. From the front and top, she gradually widens from the withers backward, and down to the abdomen.

DAIRY BREEDS

Different Breeds of Dairy Cows Characteristics of Each.

There are four major breeds of dairy cattle in the United States. They are: *Jerseys, Holstein-Friesian, Guernseys,* and *Ayrshires.* All four types have horns.

The Jerseys are the smallest, averaging from 800 to 1,200 pounds. They are usually fawn-like in color, though this varies from yellow, red, to grey, brown, or silver fawn. It is low and muscular in form. The head, short, lean, and small. The horns are often crumpled, are small, often waxy and black tipped. The ears are small, well formed, and yellow colored on the inside. The body is round and large, the neck short; the tail, long and fine.

The Holstein-Friesians are the largest of the dairy cattle, averaging 1400-2000 pounds. They came from Holland, and are black and white in color, white predominating. The head is lean and long, with straight nose. The horns should be short and curve inward. A white horn with a black tip is usually a mark of the pure breed. The neck of the female is long and slender, but in the male large and arched. The hips are large with thin thighs.

The Guernseys weigh from 1000-1500 pounds and are a yellow fawn. They probably have the same French ancestors as the Jerseys. It sometimes has white on the legs and under the body. It has a medium-sized head, with a buff colored muzzle. The horns range from white to amber or deep yellow. They are medium in length, and curve inward and upward very gracefully. The neck is fine shaped and short, but the shoulders are angular.

The Ayrshire breed is of Scotch origin and weighs 1000-1400 pounds. It is medium in size and borders on the beef type. Red, white, and brown predominte in colors. Often red and white are found, with the white predominating. The head is of medium size, with a straight face. The horns are

long, white, and often have black tips. They curve outward and upward, and often turn back at the ends. The animal has a perfectly straight back from base of horns to the tail.

The Dutch Belted cow from Holland, the Brown Swiss from Switzerland, the French Canadian from Canada, and the Kerry from Ireland are minor breeds of dairy cattle which will not be discussed here since they are little known in most parts of the State.

Care, Shelter, Food, Good Dairy Rations

Perhaps no other part of a farmer's work calls for the care that his milk cows require. To produce clean, wholesome milk, requires care and work. The cows must be curried daily to remove dirt and loose hairs. The udder and rear parts should be clipped to remove the long hairs that catch and hold the dirt. The udders should be wiped with a clean, damp cloth before milking. Care must be taken that cows are fed clean, nutritious foods, and none that will contaminate the milk in taste. Plenty of clean, fresh drinking water that is free of all contamination should be provided.

One cannot produce clean milk in unsanitary surroundings, hence the stables must be kept clean. The stables should be free of dust and cobwebs, as well as manure and litter. Plenty of light and good ventilation are of utmost importance. The floors should be of cement, and the stalls cleaned twice each day. The stable yard should be clean and well drained. Plenty of bedding should be provided, and should be changed frequently. Old straw is perhaps the best bedding, but shavings, leaves, and similar substitutes may be used.

There are many factors that enter into the consideration of food for dairy cattle. Perhaps the chief of these are: age of animal, weight, milk given, and the general characteristics of the animal itself.

Armsby's standard gives a cow 1.25 pounds of digestible protein for each 15 pounds of milk; 1.5 for each 20 pounds, and 1.75 pounds for each 25 pounds of milk.

The Wolff-Lehman standard requires for a cow weighing 1,000 pounds, and giving 11 pounds daily of milk, 25 pounds of dry matter, 1.6 protein, 10 carbohydrates, and .3 fat. If the cow gives 22 pounds of milk daily, the rations should be 29 of dry matter, 2.5 protein, 13 of carbohydrates, and .5 fats.

In considering the feeding of dairy cattle, we must consider it from the point of winter and summer feeding. In the early pasture season, the cows usually need no additional food besides what they get from the pastures, but later in the season when the pastures get short, it is often necessary to feed silage,

grain, or to cut forage, and feed it to the cattle green. In the case of heavy milkers, even when the pastures are good, it is well to give a mixture of wheat, bran, and oats.

Soiling or the cutting of green crops and feeding them fresh is a most economical way of feeding cows, but requires much extra work. Beginning May 15 and continuing to October 15, the following would prove a good soiling system:

Rye—May 15-31.
Alfalfa or wheat—June 1-10.
Red clover—June 11-20.
Clover and timothy—June 21—July 1.
Oats and vetch—July 1-5.
Oats and peas—July 6-10.
Corn, or second cutting alfalfa—July 11-31.
Corn, or second cutting clover and grasses—August 1-31.
Corn or third cutting alfalfa—September 1-30.
Rape—October 1-15.

Winter feeding is the most expensive, and upon the cost of the cow's winter food depends the dairyman's profit or loss. The food should average 7 to 10 pounds of grain per day, 15 to 20 pounds of dry forage, or 30 to 40 pounds of succulent food with 5 to 10 pounds of hay. Mill refuse, together with rye, corn, oats, barley, and wheat, are the chief cereals fed cows. These are determined by price of foods, yield of cows in milk, and dry foods fed with them.

Clover, alfalfa, mixed hays, and corn stalks are the usual dry forage. Feed all the hay the animal will eat with relish.

Silage, tubers, and roots are the chief succulent foods. Thirty to forty pounds of succulence is the average amount fed. Silage is the preferable feed of the succulent group.

Corn is the chief crop used for silage, and is second only to grass in stimulating milk production. Mangels are the most important root crop as a succulent feed. They are easily digested, palatable, and stimulate the milk flow.

Method of Improving the Herd

Constant vigilance is the price of a good herd of dairy cows. In the first place, one must start with good stock—the nearer pure the breed is the better.

Inbreeding should not be resorted to. The male should be selected with as great care as the female.

The herd should be watched carefully and scrubs or non-paying stock eliminated. A cow who does not give the standard of milk and butter fat will consume quite as much feed and require as much care as a record breaker.

Once one is sure of the breed, he must look to the care of his herd. Clean light airy weather proof barns are necessary. Plenty of good pure drinking water, a balanced ration, and human treatment are also essential. Care of the young is important. Regularity of feeding and milking are other essential points.

MILK

Composition of Milk

We are too apt to think of milk as a beverage rather than as one of our most satisfying of foods. But careful analysis shows that it is very rich in proteids, fats, sugars, and mineral matters. The mineral matter constitute about seven-tenths of 1 per cent of the entire weight of milk, more than in any other common food. Fats constitute about 4 per cent of the weights, proteids about 3.3 per cent. Proteids are found in buttermilk as the casein. Milk contains about 5 per cent of sugar, but this is milk sugar, and much different from the sugar used in ordinary cooking. Albumen is another important constituent of milk, but in a much smaller percentage than the casein. It resembles the albumen in egg white. Unlike the casein, it does not curdle when milk sours, but remains in solution in the whey. The proteid is found in much greater quantities in human milk than in cow's milk.

Different Practices in Handling Milk, Cream Separator

There are almost as many different ways of handling milk as there are people who handle it. However, they all resolve around the three main ones in use at present. Each has as its object the removal of the cream—the lighter part of the milk—from the milk proper. The shallow pan method was the one used mainly a generation ago, but since fifteen to twenty per cent of the cream was lost in this way, it has largely been given over for other methods. This method was to place milk in pans from three to four inches in depth, then put in a cool place. In twelve to twenty-four hours, the cream came to the top, and was then skimmed off. The next advancement made in the handling of milk came when the deep pan came in use. Cans twenty to twenty-two inches in height are used. The cans are filled with the milk, cooled to 40° and allowed to stand twenty-four hours before skimming. However, this method is also wasteful, since by it five to fifteen per cent, or even more, of the cream is lost. The most modern and economical method of obtaining the cream from the milk, is by a first-class separator. Separators of some type are familiar to most farm children. Perhaps it might be

well here to mention the inventor of the first really successful cream separator. He was Dr. Gustav De Laval, a native of Sweden, who died in 1913. His invention was made in 1879 and has almost entirely revolutionized the dairy business, not only in Europe but also in America. Not only has the separator saved more of the cream for the dairy man, but it makes it possible to feed the warm milk back to pigs, calves, and chickens. At this stage, it is sweet and warm, and contains all its sugar, much of which is changed to lactic acid, once fermentation has begun. Digestive disorders seldom occur in pigs or calves fed with this fresh, warm milk.

Care of Milk—Essentials in Clean Milk Production

In the care of milk there are four things extremely necessary, if one wishes to have sweet, wholesome milk or other dairy products. These are: Clean vessels, protection from air and dust, proper temperature, and protection from flies. Milk very readily absorbs odor or bacteria when exposed to the air, or placed in dirty vessels. The bacteria may be the harmless sort which are found everywhere, or they may be those of contagious diseases or those which cause digestive trouble that prove so fatal to babies. Bacteria multiply rapidly while the milk remains warm—that is, 50° F. or above. Cleanliness and a low temperature are extremely necessary if one would have good milk. No milk should ever be bought anywhere that is sold from the open can or other container. Practically all the milk sold now is bottled milk that the law compels the seller to pasteurize.

When the milk has been delivered, the bottle should be carefully wiped off and put in a refrigerator at once. The milk should be emptied from the bottle only as used, and under no circumstances should milk once poured from the bottle, be poured back in the bottle, if there remains any milk in the bottle. To do so may cause the whole to sour. The paper cap should always be used to cover the bottle.

There seems to be little need to urge on thinking people the necessity of protecting milk from flies when we know that on the average, each fly carries at all times about 1,250,000 bacteria, many of them bacteria of tuberculosis, typhoid, and cholera infantum.

But our care of milk should not end with the bottle itself, but should extend to the refrigerator or cellar where milk is kept. Daily and constant care is needed to keep these sweet and clean at all times, yet if one but thinks that on these depend the health of all who use the milk, little urging will be needed.

The essentials of clean milk production have been touched upon in a previous topic, but an additional word here may be

wise. Constant vigilance is the price of clean milk, and this vigilance begins first with the cow. No cow should be milked which is not sound physically. Next her feed and drinking water must be good, fresh, and abundant. Her stable or stall should be clean, airy and well ventilated. The cow herself should receive daily care, while the milker's hands and clothing must be clean. Duck cloth that is washable makes ideal milkers' outfits. The buckets should be clean, and with small opening at the top. As soon as the milking is finished, they should be covered with clean cloths.

All utensils used for milk should first be rinsed, washed, and scalded every time they are used. Do not wash them in the dish water. Nor is it necessary to dry them—scald and drain, preferably in the sun. Dairymen are fast coming to the point where they no longer grumble at the time such precautions are taken. They believe in "Safety First."

Bacteria; Sterilization, Pasteurization

Many of us have never seen bacteria because they are so tiny that they are visible only with a high powered microscope. Yet we have all seen how they act. We may have a cup of milk which is perfectly sweet tonight, but if we leave it setting in a warm kitchen all night, it will perhaps be clabber in the morning. This is the work of bacteria.

Let us take a sample of milk and see how rapidly bacteria multiply. Suppose the sample contains but 13,000 bacteria per cubic centimeter. This is very low, and milk with such a low count must have been produced under very clean conditions. In 36 hours, if we do not pasteurize it, the count will have increased to the enormous total of 52,500,000. This shows the need of sterilizing all milk vessels, and then pasteurizing the milk.

There are three chief ways of pasteurizing milk. First, the Flash System, which consists of heating the milk to a temperature of 166° F., held there for a few seconds and rapidly cooled to 40° This changed the taste somewhat and is little used now. Second, the Held System heats the milk to a temperature of 145° holds it there for 25 minutes, then rapidly cools it to 40°. The third or Bottle System consists of heating the milk in bottles to 145°, then cooling. It is little used now.

By sterilization we mean the scalding of all utensils, cloths, brushes, separators, or other articles used in handling milk. Immersion in boiling water or steam is the usual means of sterilizing an article.

Butter, Test Milk for Butter Fat; Value of Butter

Without hesitancy, one may say butter is the chief milk product. In composition this is about 85 per cent fat, 11 per cent

water, 4 per cent salt, and 1 per cent casein. Color, flavor, texture, and general appearance are considered in grading butter. In color it should be a bright, golden yellow. The flavor is impossible to describe.

It is said that the Arabs centuries ago first discovered the art of butter making, when butter was formed when milk was carried in a goat's skin on a camel's back. From this primitive churn, the art has been perfected up to the dasher churn of our grandmother's day, to the box and barrel churn now in use. A detailed discussion of butter making is not possible here.

Two things determine whether or not a cow is profitable—the quality and quantity of her milk. The quantity is more easily tested—and is done simply by weighing the milk each day, but testing for quality is slightly more complicated, but plays such an important part in dairying that no dairyman can afford to neglect it. This may be done by a Babcock tester, a device which separates the fats from the other solids, and weighs them.

This Babcock tester may be purchased from any dairy supply company for about $5 or may be ordered through a hardware dealer. By its use a farmer can soon ascertain which of his cows are paying, and which are not. It one wishes to grade up his herd by breeding, this is one of the best ways to select his cows for breeding purposes.

Many country homes now have some means of testing milk. These should be discussed in class, and examples brought to school if practicable.

Value of Butter

Butter as we all know, is made of sour cream, which is churned at a temperature of 50° to 54° in summer and 54° to 58° in winter. Butter generally contains besides its fat, 1% protein and 18% salt, curd, and water.

CHEESE

Cheese is perhaps the next most important milk product, and is made by coagulating milk with the ferment from the calf's stomach. Milk rich in fat makes more and better cheese than thin, blue milk.

Cream cheese should contain 37 per cent water, 34 per cent fat, 24 per cent casein, and 5 per cent ash. Cheese is one of our most economical foods since 95 per cent of it is digested when eaten.

Cottage cheese is one of our best known cheese since it is made at home. Cheddar is one of the best known makes of this country. Until the war, most of our fine cheese was imported from Holland and Switzerland or France, but cheese making

now is making great strides in this country, and once trade is resumed on a pre-war basis, it is hoped the European markets will find we have products that will rival their best.

Some of the best known of the imported cheese are:

Limberger, given its peculiar odor by specific fermentation during ripening.

Swiss cheese, which is flavored with herbs and by certain native pastures when the cows feed. It is world-widely known.

The French Roquefort cheese is made both from goats' and cows' milk. It is made by mixing moistened bread with clotted milk. It is dried, salted, and then placed in mountain caves to ripen.

Cheddar, Cheshire, and Stilton are the most famous English cheese.

The round Dutch cheese, colored red, and called Edam, from a town of that name in Holland, comes from Holland, and is made of partly skimmed milk.

Brie and Camembert are soft French cheese of fine flavor.

BEEF CATTLE

Characteristics of Beef Type, Compare with Dairy Type of Cattle

Beef cattle may be divided into two general classes—first, strictly beef cattle, and second, dual purpose breeds. The former are valuable mainly for the production of meat, and have been bred and developed so that they will produce a maximum amount of beef of superior quality.

The dual purpose type are intended to produce a fair amount of good meat, while the cows are expected to give a good flow of milk. The breeds of beef cattle in the United States are:

Shorthorn, sometimes called Durham, Polled Durham, Hereford, Aberdeen-Angus, and Galloway. With the exception of the Shorthorn, these cows are not heavy milkers. The milking tendency accompanies that shape of body which prevents the animal from yielding the greatest amount and the highest quality of beef. A good beef-bred cow should give only enough milk to nourish a good healthy calf.

Among the dual purpose breeds we find certain types of the Shorthorn, together with the Red Polls and Devons.

In the beef type, since it is desirable that the animal fatten readily, the food should go to produce flesh. The quality of the flesh in various parts of the body varies greatly, hence it is desirable that beef cattle take on flesh in those parts yielding the valuable cuts of meat. Take, for instance, the lower leg, usually sold

as soup meat. This cut will sell for one-half to two-thirds less than the porterhouse taken from the back.

In general, the beef type resembles a brick set on edge. It offers parallel lines whether viewed from side, top, or bottom. Th animal is as deep in front as behind. The animal is stocky and compact, almost straight of line from ears to tail. The back is broad from shoulders to hips. "Blocky" is a term often applied to the ideal beef type, and well describes the compact, squareness of form.

But the dariy type is much different. Viewed from the three angles, she presents a wedge shape. She is angular rather than compact, while her rear development is much greater than her front.

Beef Breeds, Characteristics; Uses

The Shorthorns are natives of England, have horns, and weigh 1400-2000 pounds. In color they are red, white, and roan. It is the largest breed of beef cattle, and closely approaches the ideal beef type. The head is short, and between the eyes, is broad. The horns which are small and short usually curve forward. The neck is short and thick, the back broad and straight. The rump is long, broad, and level. The thighs and quarters are deep, long, and thick, the flesh being well toward the hocks. The short legs have small, clean bones, and strong joints. They have a very good disposition.

The Hereford, like the Shorthorn, is also hornless and originated in England. It weighs 1400-2000 pounds, and is red and white in color. It takes its name from Hereford County, England, where it originated. It is one of the oldest breeds of cattle in England.

The head is short, with a broad, slightly dished face. The horns are white or yellowish, which spring forward and up in the cows, but down in the bulls, with a graceful curve. The neck is short and smooth. The chest is broad with often an over-developed dewlap. The back is straight with long, wide, well-sprung ribs. The rump, however, is less well developed than in the Shorthorn, while the thighs are thin, lacking thickness and depth. They are also not so gentle in disposition as the Shorthorns. However, their three main points of excellence are:

1. They take on fat at an early age.
2. They are unexcelled as baby beef producers.
3. They do well on open range grazing.

The Aberdeen Angus cattle are hornless and are natives of Scotland. They range from 1400-1800 pounds, and are black in color. The head of the Aberdeen-Angus is short, with prominent forehead, which tapers at the poll. The ribs are well sprung but

rounded, which does not give the broad back found in the Shorthorns. The rump slopes a good deal, while the thighs are thin. While in some points the Aberdeen-Angus is inferior to the Shorthorn, its owners insist its meat is superior in flavor to that of the Shorthorn.

The Galloway are the smallest of the beef breeds, ranging from 1200-1800 pounds. In color they are black, and, like the Aberdeen-Angus, are natives of Scotland and hornless. It is a very old breed and its origin is obscure. Its long, shaggy coat of hair fits it to thrive in cold climates. It has a well-shaped head, but less peaked at the poll than the Aberdeen-Angus. Its back is straight from poll to tail head, but its ribs are deficient in spring. Some hold that the Galloway do not mature as early as the other types of beef cattle, but they produce a very high grade of meat, fine in grain and flavor. The Galloway is of a very active temperament. It is the hardiest of all beef cattle, while its hide is very valuable because of its long, silky hair. It is used to make robes, coats, and such articles.

Dual Purpose Cattle

The use of the beef breed is for meat purposes alone, while the dual purpose type may serve either the purpose of dairy or beef cattle. The dual purpose type is often preferred by the farmer for this reason, especially if he keeps but a few head at any one time.

Among the dual purpose cattle are the *Polled Durham cattle,* natives of England, and hornless. They average 1400-2000 pounds in weight, and are red, white, or roan in color. They are very similar to the Shorthorns and are often called the hornless Shorthorns.

The Devon cattle are natives of England, have horns, are red in color, and weigh 1200-1800 pounds. It has graceful, upturned, black-tipped, waxy horns, and is very symmetrical in general appearance. It has often been called deer-like, owing to its natural refinement, and nervous disposition. The oxen of this breed ranks high.

The *Red Polled* come also from England, and are hornless. They are red in color and average 1200-1800 pounds in weight. It is often given first rank among the dual purpose breeds. It lacks in massiveness, and shows many dairy-breed features.

Sussex cattle are natives of England, have horns, weigh 1200-1800 pounds, and are red in color. This breed resembles the Devon except its general appearance is coarser, has greater size, and is beefier.

The *West Highland* breed is of Scottish origin. It has horns, is red or black in color, and is the smallest of its class,

weighing 900 to 1200 pounds. It is especially noticeable because of its shaggy coat of hair and small size. It also matures late, fattens slowly, and is very nervous in disposition. It is hardy and rugged and very attractive in appearance. The quality of its meat is unexcelled.

Care of Beef Cattle

One of the greatest needs in the successful raising of beef cattle is *regularity in watering and feeding.* Another important point is the *securing of good stock to begin with.* It is usually too expensive to make any great purchase of pure-bred stock to begin with. It is far better to *"grade up" on native stock.* The cattle feeder should *never* be tempted to *fatten heifer* calves *from good cows* for beef. They should be kept for breeding purposes.

Good pasture is one of the most essential features of summer feeding. A feed bunk proves of great help in feeding grain. This is three feet wide, fifteen feet long, and two and one-half feet high. This will accommodate twelve to twenty cattle. Many cattle men make use of the self-feeder, where it is necessary to economize on labor. Others do not like them. *Shade, either natural or artificial, must be provided* during the hot season, when the excessive heat and flies do much to excite a herd of feeders, so that they may stampede and injure one another. One of the important factors in feeding cattle is an *abundant supply of fresh, pure water at all times.* A mud hole is no place to allow cattle to drink. The hotter and dryer the weather, the more water cattle need, and the scarcer it is apt to be, especially if one has to depend on hand pumping to supply it. *Salt* should be placed under a shed or other protection, where the cattle have free access to it.

Winter feeding is no less important, and much more expensive than summer feeding. One of the greatest *winter essentials is proper shelter.* The fattening steer does not require the warm quarters required by the dairy cow, but it does require dry quarters, and a dry, comfortable bed. *The feed lot should have a good drainage* and some natural protection. For the location of the feed lot, a south slope is best. A muddy feed lot is hard both on man and beast. In many sections of the corn belt the soil is of such a nature that a paved feed lot is the only logical solution of the matter. This should have a grade of at least one inch to each six feet. When the natural drainage is good and the character of the soil such that entire paving of the lot is not necessary, to pave it around the water tank, forage racks, and feed bunks may prove sufficient. It is

never wise to combine dry forage racks and feed bunks. Each should be separate. Such feeding places should be built in sheltered positions but not necessarily under sheds.

Food and Balanced Rations of Beef Cattle

Since cattle feeders have found out that young animals fatten more readily than old ones, the experienced feeder chooses his cattle accordingly. To make even a fair profit the cattle feeder must have animals that will make rapid and economical gains in the feed lot. A rapid and economic feeder will not possess much flesh at the beginning of the feeding period.

The quantity of food required for feeding depends on the age, weight, condition, and individuality of the animal, as well as upon the kind of food. For this reason, it is impossible to give any arbitrary rule for feeding, but this may be taken as a working basis.

For an animal 2-3 month old, weighing 160 pounds, 23 pounds of dry matter, 4.2 protein, 13 of carbohydrates, and 2 of fat are required.

3-6 months, weight 330 pounds, 24 pounds of dry matter, 3.5 of protein, 12.8 carbohydrates and 1.5 of fat.

6-12 months, weight 550, requires 25 pounds dry matter, 2.5 protein, 13.2 carbohydrates, and .7 fat.

12-18 months, 750 pounds in weight, requires 24 pounds dry matter, 12.5 carbohydrates, .5 fat.

18-24 months, weight 950 pounds, 24 pounds dry matter, 1.8 protein, 12 carbohydrates, and .4 fat.

During the first period of fattening cattle, 30 pounds of dry matter are required, 2.5 of protein, 15 of carbohydrates, and .5 fat.

During the second period 30 pounds of dry matter, 3 of protein, 14.5 of carbohydrates, and .7 of fat are required.

During the third period, 26 pounds of dry matter, 2.7 protein, 15 of carbohydrates, and .7 fat are required.

Some stock men purchase large numbers of cattle in the fall in order to feed up such roughage as corn stalks, straw, inferior clover hay, seeded clover, and such. This is an economical way of disposing of such crops, and cattle so fed in the winter fatten readily when turned on pasture in the spring. This roughage increases their feeding capacity, and cattle so fed during the winter show much more rapid summer gains than those fed a heavy grain feed during the winter. However if this method is used, the latter part of the feeding period must be used to reduce the paunch and round up the steer.

Summer feeding on pasture has many advantages over winter feeding, in that no bulky foods are to be handled, no bedding to provide, no lots to clean, and many other tasks requiring time and labor are eliminated. There are two methods of summer feeding—pasturing with no grain and pasturing with all the grain they will eat. Which method one uses will depend upon the amount and condition of pasture available, cost of grain, and condition of animals. Cattle fattened wholly on pasture cannot be brought to the point of perfection that grain fattened cattle can be, and hence do not bring as good price on the market. For this reason, it is usually more profitable to feed some grain along with the pasture.

Care should be used in turning on grass too suddenly in the spring. The first day two hours in the afternoon is enough, the next day, they may be turned out at noon, but not till the third of fourth day should they be allowed to remain out all day. Turning them on succulent grass, especially clover or alfalfa wet with dew or rain, is very apt to cause bloating in the cattle.

Many factors enter into the consideration as to how much grain to feed cattle while on grass. If a thick fat is desired, they should be fed throughout the summer. Cattle intended for fall market need not be fed until pastures get short—usually in July. Others feed from the beginning of the season and plan to sell along in mid-summer before the pastures fail. Some prefer corn as a feed alone, but for young stock, it is perhaps wise to feed something in addition that is rich in protein, as linseed or cotton seed meal.

For the farmer who is short of pasture space, but has an abundance of corn and dry forage, winter feeding is usually the most profitable. This system has its advantages over summer feeding, in that the work can be done when the farmer is less rushed with farm work. The cattle are not troubled by lack of water and flies. It also forms a way to secure quick returns from forage crops as well as grain, since the steers are on the market before farm spring work begins. The kind and amount of winter feed depends mainly upon the age of the animals. Young animals will need a grain feed from the beginning, but older animals usually fatten if the grain is fed for sixty days before marketing. The kind and amount of grain depends largely on the dry roughage.

The following standard tables will give some idea of amounts and kind of food required.

Study of Standard Tables

Fattening cattle.	Dry Matter	Crude Protein	Carbo-hydrates	Fat
1st period	30	2.5	15	.5
2nd period	30	3	14.5	.7
3rd period	26	2.7	15	.7

This table follows the Wolff-Lehman Standards, and is suggestive rather than arbitrary. External conditions, age of cattle, etc., must be taken into consideration also.

Marketing

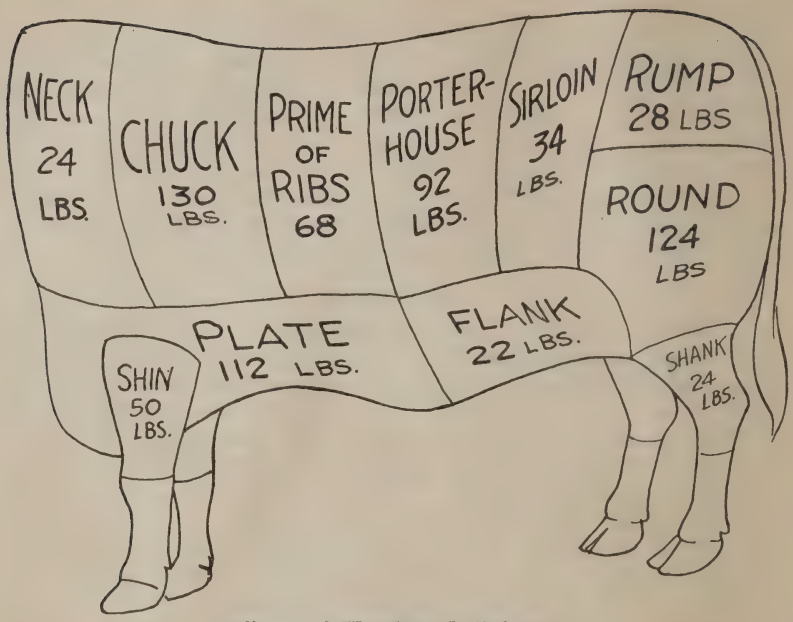
Perhaps no part of the cattle raisers' work is more important than the marketing of his finished product. This is done in one of the following ways—either by slaughtering them himself or "on foot," or alive. The former is the more profitable in some regions, but since all our great cities have stock yards with their attendant slaughtering and packing houses the latter has become more common. The shipping of live stock has reached such a large growth that special cattle cars have been built for this purpose, and often whole trains will be composed of them alone. The stock yards of East St. Louis and of Chicago are both well known centers of beef cattle trade in Illinois.

NOTE.—*Have students bring in reports of market quotations, lists of commission firms, and other matters in connection with these two markets. Have them also give instances of some local man who has topped the market with animals of any sort. Also discuss with them charges made by commission men, charge for "yardage," how cattle are graded first into (a) beef cattle, (b) butcher stock, (c) cutters and canners, (d) stockers and feeders, (e) veal calves. These are subdivided into prime, choice, good, medium, common and inferior; also discuss Government inspection and quarantine. This can be made a most interesting and profitable topic, if handled rightly. Encourage pupils to bring agriculture papers to school, to read, and discuss them.*

Cuts of Beef

In studying the cuts of beef, it would be well to have an outline sketched on the board and then have the students locate the parts. The diagram on following page is merely suggestive.

Using this diagram it would be well for the teacher to show how the beef type of animals have the flesh in the parts that furnish the best cuts of beef. Have students compare cost of different cuts; 75 per cent of the value of a beef steer is in the valuable parts, the rest—25 per cent—being in the less valuable cuts. What are included in the former? What in the latter?



Care of Herd and Calves

The care of cattle has been discussed along with the treatment of both dairy cattle, and will be given only as a resumé here.

Beef cattle should be given either natural or artificial protection during the heat of summer, also plenty of good, fresh water. In winter, they should be protected but need not be housed as warmly as dairy cattle. The feed lot should not be allowed to degenerate into a mud hole.

Dairy cows need warmer quarters than beef cattle, and require more attention to their surroundings and for themselves in order that the milk production may be sanitary.

Every farmer has his own ideas about raising calves and no one can make statements in regard to their care that some will not dispute. Some prefer to have the calf with the cow for about ten days, others prefer to separate them the third or fourth day, or even the second, if the calf is strong. If hand feeding is resorted to there is danger of overfeeding the calf and causing serious digestive disturbances. While the calf is still young it is best to feed it the milk of its own mother, while it is still warm. This should be done three or four times a day, and about one and one-half to two quarts each time. At four weeks of age, the change to skim milk may be made. This change should be made gradually, about one pound each day being skimmed. In this

way, the change is made without the calf's noticing it. After two or three weeks of age, the calf should be taught to eat a little grain. This is done easiest by putting a little in the pail after the calf has finished drinking. At six weeks old, the calf should have daily one pound of the following mixture: Corn meal, three parts; three parts ground oats, three parts wheat bran, and one part linseed meal. If it is desired that the calf have no horns, as soon as the young horn can be felt with the hand, slip away the hair, wrap a stick of caustic potash in paper so as to protect one's hand, dip the end of the stick in water and rub this upon the growing tip of the horn until the skin begins to loosen up and turns red. Care should be used not to touch the surrounding skin. In a few days the place heals over, and no other application is necessary.

NOTE—*Teacher should have students report in class on calves they have raised, bred, treatment given them, results and final disposal.*

Methods of Improving the Herd.

The ways of improving the herd of beef cattle are much the same as those employed to improve a herd of milk type. Above all a good breed must be selected. Scrub stock never pay for feed or time spent on them. Certain characteristics should be selected as especially desirable, and animals bred with a view of securing this characteristic. Feeding is especially important in keeping beef cattle in good condition. Care should be given to secure a balanced ration. Green food while of value is not so important as in the feeding of dairy cattle.

Fresh water is a prime requisite as is a clean barn and sufficient shelter from the weather.

The feeding, breeding, and care of beef cattle are no longer the hit and miss affair it was years ago when cattle were allowed to range over the prairies, were rounded up, corn fed for a few weeks, and marketed. It has been reduced to a science as exact as any that the farmer deals with. Rightly managed, breeding and feeding beef cattle is extremely profitable, but it is a subject so vast in scope it cannot be dealt with here adequately.

Projects

1. Collect good pictures of different breeds of cattle and mount, group into dairy and beef breeds.
2. Plan to raise a calf; keep a record of expenses; receipts; profits.

Horses

The horse is one of the oldest known animals, yet its use as a work animal is of comparatively recent origin. During Biblical times, the horse was used merely as a means of locomotion, and the oxen as the beast of burden. This is true in some respects in Europe at the present time, and especially true in Asia. Within the last generation, oxen were used in the United States in farm work, and that their use has been discontinued is due to two factors—the American demand for speed, and the increasing use of cattle for meat purposes.

The origin of the horse is really unknown, having been known to civilization from early times. The wild horse of Europe is undoubtedly the original source, but centuries of breeding have developed many types much unlike the original animal. The beautiful horses of Arabia are famous the world over, but their owners have always proved most secretive as to their breeding and ancestry.

The Horse as a Mammalia; Characteristics; Types of Horses

Like the cow, the horse is a mammalia, or milk-fed animal when young. It is also an ungulatis, or hoof animal, but is a perissodactyla, that is, the hoof is developed on the middle toe, instead of being an artiodactyle, like the cow, that has a hoof developed on the two middle toes.

There are two distinct types of horses—the light and heavy. The former is used in light, swift work, while the latter or draft horses are the real beasts of burden.

It has many characteristics which mark it off from animals in general. Perhaps the first of these is its higher degree of intelligence. A good horse seems almost to show human intelligence. It is also capable of being trained to a degree unattained by sheep, cows, or any other animal except the dog. Breeds of horses differ so much in characteristics that it is difficult to make any statement that will hold good for all. Hence, the personal characteristics of each breed will be discussed under the separate heads or breeds.

As was said before, there are two types of horses—the light and heavy. The light type is further divided into running, trotting, pacing, saddling, coaching, and various other types. While all light types have some points of similarity, the vairous types have sharply distinguishing features. The light type is usually tall with long limbs. The animals are narrow, but deep in front. It has been well compared in body formation to the greyhound.

In a general way, the draft type resembles the beef cattle. It is massive, rather blocky in shape, limbs short, and resembles

the bull dog in shape. Weight is the one main feature of the draft horse. At maturity a good draft horse should weigh 1500 to 2400 pounds, according to his class.

Different Breeds of Horses in Neighborhood

Since this work is to be used in various sections of the State, a general survey of the more common breeds will be given.

The horse is very susceptible to climatic conditions and quickly shows it in change in general appearance. In the temperate regions, where we find fertile, grassy plains, we find horses noted for size and strength. For this reason, it is the plains of France and Germany that have produced our heavy draft breeds. These regions are the source of these horses. But these animals have lacked quality and activity so essential in the first-class draft animal, so by breeding with light horses, these points have been improved. Each of the draft breeds has been founded on the light horse.

The light breeds in turn have been improved by inter-breeding with Arabian horses.

The Thoroughbred horse is one of the most popular with English sportsmen, and is really the source, together with the Arabian horse, of all the light breeds of quality. It is a native of England. It stands 14 to 14½ hands high, weighs 800-1000 pounds. In color it is bay or brown and is used mainly for racing. The history of the Thoroughbred is obscure. Its origin was probably the original stock of the country, bred up by Roman horses brought over in the days of Cæsar. German horses were also used in breeding up the stock, and Spanish horses were later introduced. Charles II. of England was the first to bring into the country the Royal mares from Arabia, and other parts of the Orient. The late part of the Seventeenth and the early Eighteenth Century saw the greatest advancements in this breed.

The Thoroughbred has a fine, lean head of moderate size. The eyes are prominent and intelligent, while the medium sized ears are carried well up. The neck is long and fine and joins shoulders sloping obliquely back. The chest is narrow but deep, and the body cylindrical. The croup is long and level, and the tail carried gracefully. The distinguishing feature of the breed is the hindquarters, which are long with strong muscles, of great driving power. The knee and hock joints are medium in size and strong, while the legs above are strong, with distinct muscles. The feet are of medium size, are wide, and high at the heel. The action is one of the most important features, and should be straight, free, and easy. Because of generations of breeding for races over long, straight tracks, the Thoroughbred has developed great endurance at high speed.

The Arabian horse, as its name implies, is a native of Arabia, is 14 to 14½ hands high, is bay or white, and is used mainly for riding. It weighs 800-1000 pounds. Little is known of the early history of these horses. Some say the great endurance of these horses is due to the difficulty they found in securing pasturage, so that all but the most hardy died. Others say there is a peculiarity of the scanty Arabian horses which goes to produce fine, firm bone. However that may be, the finest horses of this type in the world are found among the migratory Bedouin tribes of Arabia. Compared to the Thoroughbred, the Arabian is more stylish and less angular. The Arabian horse has a shorter body, with longer ribs, and more curved, thus giving the body a straighter underline. The legs are shorter. He has great endurance and stamina, and has a more stylish carriage of head, neck and tail than the Thoroughbred, but is not nearly the equal of the latter in speed.

The American Saddler is a native of the United States, is 15-1½ to 15-2½ hands high. It is bay, black or brown, is used for either riding or driving, and weighs 950 to 1050 pounds. This horse was really the product of necessity, for in the early days of our country, before we had railroads, the horse was the sole means of transportation. Thus the use of the saddle horse became very common and in our southern States, especially Kentucky, Virginia, Tennessee, and Missouri, much attention was given to breeding this type of horse. Because of the fact that Kentucky made so many improvements in this breed, it is often spoken of as the Kentucky saddle horse. The Thoroughbred was used largely in breeding up this animal, and most of the noted saddlers today are descendants from Denmark, a noted Thoroughbred. Compared to the Thoroughbred, it is taller and heavier. It has greater symmetry of form, and greater style in carriage of head, neck, and tail. It has a very easy gait, which is very distinctive. They are divided into two classes, according to their gaits—the walk-trot-canter horse, and the gaited saddle horse, which walks, trots, canters, racks, and does one or more of the three slow gaits, the running walk, the fox trot, or slow pace. The former is the most usual saddle horse.

The Standard Bred is also a native of the United States. It is 15½ to 15¾ hands high, weighs 900-1150 pounds, is used for driving or racing, and is bay, brown, or black in color. This breed is a road type and includes both pacers and trotters—indeed, the same horse may pace one time and trot the next. It is of American origin, but has been graded up by trotting horses imported from England. The English Thoroughbred played a great part in its improvement. A Thoroughbred, Messenger, imported in 1788, and Bellfounder, imported in 1822, did much to improve

this breed. Hambletonian, a descendant of Messenger and a Standardbred horse, was perhaps one of the most noted horses ever born in America. The Standardbred is America's principal race horse, and speed at the trot is the main requirement. In shape this breed is rather angular with prominent, strong joints. The ribs are more or less noticeable. It has a straighter underline than the Thoroughbred, mainly because of its longer ribs. Powerful trotting or pacing action is essential. It must be true, and vary neither to right or left.

The famous Dan Patch was one of the most famous of this breed. In 1903 at Memphis race tracks he made ½ mile in 56 seconds. The same year at Macon, Ga., he made 2 miles in 4.17 minutes, while in 1905 at Memphis he made 1 mile in 1.55¼ minutes. In 1874 Lady St. Clair of this breed made 5 miles in 12.54¾ minutes in San Francisco.

The Coach Breed of horses is really a cross between the light and draft horses; yet since it tends more to the former than to the latter, it usually is classed under that head. They are distinguished for stylish action, yet useful for heavy coach or carriage work. They owe their origin mainly to the Thoroughbred and Arabian horses, which were bred with the heavy draft horses, and produced a breed smaller in size than the draft horse, yet more stylish in action and of greater endurance.

The Hackney Coach is a native of England, weighs 1000-1200 pounds, is used for park driving, is chestnut in color, and stands 15½ to 15¾ hands high. It is blockier in form than any of the other breeds of the coach horses. It is short legged, has a big, broad back, intelligent head, neat neck, strong, powerful loins, and a perfect shoulder. The stylish, attractive action, especially of the knees and hocks, that is its chief merit. Up to the time of the auto it was in especial demand for fashionable driving.

The French Coach horse is a native of France, but is not known by that name there but by the name *Demi-Sang* or half-blood. This name was at first given to offspring of Norman Draft Horses and English Thoroughbreds. It stands 15 to 16 hands high, weighs 1200 to 1350 pounds, is used for coach driving and is bay, or brown chestnut in color. The French Government has done much to encourage this breed, and to its aid, the French coach horse or Demi-Sang owes its present perfection. In general outline, it is not so smooth as the Hackney. It is a larger horse, has good body length with long, slightly-arched neck. It has larger bone and more powerful muscles. The action, instead of being high and flashy, as in the Hackney, is longer and more powerful.

The German Coach horse was developed in northwestern Germany. It varies much in size and weight, from 16 to 16½

hands high, and from 1350 to 1450 in weight. It is used for heavy coach driving, or as a general utility horse. In color it is black, brown, or chestnut. It lacks the smooth outline and the symmetry of the Hackney. The action of the trot is longer, and lacks the high stylish action of the Hackney.

The following are the main breeds of draft horses:

Percheron, French Draft, both natives of France; Clydesdale, a native of Scotland; Shire and Suffolk, both natives of England, and the Belgian, a native of Belgium. All are used for heavy hauling. The *Percheron Draft* horse was developed especially in the region of La Perche, although they are found all throughout northwestern France. Oriental horses played a big part in the development of this breed. In the Eighth Century, during the Saracen invasion, great numbers of Arab, Barb, and Turkish horses were brought into the country. For over 200 years the French Government has aided much in the improvement of the draft horses. The Percheron is 15½-17 hands high, is grey or black in color, and weighs 1800-2300 pounds. It is the most important draft breed in America. In form it is heavy and low set. Its weight is right for the ideal draft animal. The head is large and slightly heavy. Its face is straight, with large nostrils. The neck is short, strong, and well crested. The back is short, the chest deep and broad, the loins smooth with heavy muscles. On top the body is rather short, but long below. The ribs are strongly arched, and give a great depth. The croup is broad and wide, but with a steepness not desirable. The joints are medium, but strong and legs heavily muscled. The feet are large. The action is strong and true, and good both in trot and walk. It is a good mover, and if surpassed in this respect at all, is by the Clydesdale.

The French Draft horse includes a number of types. Indeed the Percherons may be included in this number. It is common to refer to any draft horses brought from France as French draft horses, but this includes such as the Bretons, the Ardennais, the Picardys, the Nivernais, the Percherons, and the Boulonais.

The Clydesdale Draft horse weighs 1800-2300 pounds, is a light bay, and stands 16 to 16½ hands high. These horses owe their excellence to early interbreeding with the English horses, and to the soil of Scotland, which is able to support by forage large framed animals. Baron of Buchlyvie, a Clydesdale draft horse, sold for $47,500, the highest price ever paid for a draft horse.

The Clydesdale differs from the Percheron in its action, its hairy legs, and in its markings, which are a white blaze on the face and one or more white feet. From the backs of the legs there is a heavy growth of long hair called the feather. It has

longer legs than the French draft, the body is longer and lighter, and the nose is often slightly Roman.

The Shire stands 16 to 17 hands high, and weighs 1800-2300 pounds, and is light bay in color. In color and feather of the legs, it much resembles the Clydesdale, but in shape, more the Percheron. It is perhaps more powerfully built than either, but lacks their graceful action. This is perhaps due to its straight shoulders, and short, heavily muscled legs.

The Belgian draft horse stands 16-17 hands high, weighs 1600-2300 pounds, and is bay, brown, or black in color. This breed is unlike other draft breeds, the result almost entirely of its own surroundings, and no one breed has been instrumental in aiding its improvement. It is even more compact than the Percheron, and has the maximum weight for its size. It has a very full breast, very broad and deep back, and the greatest body girth of any breed. The rump is short and steep, and has the objection of a low set tail. The nose is straight; it has no feathers on the legs as have the Shire and Clydesdale.

The Suffolk draft horse stands 16-17 hands high, weighs 1600-2000 pounds, and is chestnut or bay. This breed is little known in America. It is smaller than the other breeds, although it has greater body depth and circumference than the French horse.

Because of the small number of ponies in this region, they will not be discussed at length here. The chief breeds in America are: Shetland, Welsh, Exmoor, Arabian, Hackney, and the Mexican and Indians, which dealers do not recognize as breeds. In the South these ponies are called Mustangs; in the central and western states they are called Bronchos, and in the North, they are often spoken of as Cayuse.

Uses of Horses

The use of the horse on farms and in cities is varied. In the latter however motor vehicles have largely taken the horse's place. This is due to two things—the increased speed of the motor vehicle which saves much time and the less expense both of time and money in maintaining and caring for a car.

In large cities especially horses are mainly seen on the bridle paths of our parks where they are ridden solely for pleasure.

In the country, the horse has continued to hold its own better than in the city. While motor driven machinery has taken the place of horses in some farm activities, it will be a long time before they are wholly replaced. Owing to the difficulty of using motor vehicles in muddy weather the horse will continue to hold his own as a means of accomplishing the average

hauling or pulling on the American farm. As one writer on the subject has well put it the motor is supplementing not supplanting the horse.

How Horse Power on the Farm is Supplemented by Other Kinds of Power.

On the average farm, horse power is supplemented by various other kinds of power. Sometimes this power takes the place of gas stationery engines, More often it takes the form of automobiles, Fordsons, or similar motor vehicles.

Especially is this true in the West where thousands of acres are owned and cultivated by one man and his hired help. Here a motor power engine will accomplish more work than a dozen horses in plowing, hauling, cultivating, and other kinds of heavy work.

Electricity as yet is undeveloped along lines of supplanting or even supplementing the work of the horse on the farm. It has its uses around the home in churning, lighting, ironing, etc., but still is limited to that field.

The Horse as an Animal, Characteristics; Parts; Head; Ears; Eyes; Neck; Legs and Feet. Compare Foot with that of Cow; Mouth; Teeth; Number; Kind; Relation to Age

A horse's usefulness is limited wholly by his power of locomotion. In form he consists of a squared arch, which is supported by his legs. The balance of this arch or the body is determined largely by two things—the hang of the head and tail. While all the legs serve to support the body, the greatest weight is borne by the forelegs, the hind legs in locomotion acting mainly as propellors.

The horse belongs to the same general class of animals as the cow, being a mammalia. Like the cow, there are two general types. These are first for heavy work, and second for speed. In general, their characteristics are the same. Roughly speaking the horse may be divided into four parts. First, the head and neck. The forehead should be broad, full, and flat. The ears should be medium in size, pointed and carried alert. The eye should be large, full, bright, clear, lid thin, prominently set, intelligent.

The muzzle should not be too fine, nostrils not dilated, lips thin, teeth regular and sound. The neck should be curved and the head well set.

The forehead includes the withers, shoulders, arms, forearms, knees, canon, fetlocks, pasterns, feet and legs.

The feet should be of a size proportional to size of horse. The hoof should be smooth and dark colored.

The third division is the body, which contains the chest, ribs, back, and loins. The chest should be deep and full. The ribs long well sprung. The loins should be broad, strong, full, deep.

The fourth division is the hindquarters and include the hips, croup, tail, thighs, stifles, hocks, canons, fetlocks, pasterns, feet, legs.

It is difficult to give any description of a horse unless one specifies draft or speed types, for the thing that might point one out as a high bred horse of one type, would perhaps utterly condemn it as a pure bred horse of the other.

The horse's foot when compared to that of a cow is seen to be much different. The cow has two well defined toes, the horse has a single toe or hoof. Perhaps it will make it clearer to us if we place the tip of the middle finger of our hand on the table, holding the hand meanwhile upright. The nail of our finger will represent the hoof of the horse, the finger corresponds to the pastern, the middle bone of your hand to the canon, the forearm to the horse's forearm, and the arm to the arm, so-called of the horse.

If we take the hind leg of the horse, and imagine ourselves standing on the tip of our middle toe, the toe nail will correspond to the hoof, the toe to the pastern, the ball of the foot to the feltock, the heel to the hock, the shin bone to the leg and the knee to the stifle.

Mares have eighteen teeth in each jaw—six incisors and twelve molars.

Geldings and stallions have in addition two canines, making twenty teeth in each jaw. The first three molars and all the incisors are temporary and are replaced.

Cattle have no incisors on the upper jaw and eight on the lower. In number the molars are the same as those of the horse. The first three are temporary and are replaced as are those of the horse.

The following table may be of aid in telling the age of horses from their teeth:

Kind of Tooth	Location	Appear	Replaced
Molars.....	First	Birth	2½
	Second	Birth	3½
	Third	Birth	3½
	Fourth	About 11 mo.	Are not replaced
	Fifth	2 yrs.	Are not replaced
	Sixth	4½ to 5 yrs.	Are not replaced
Canines.....		4-5 yrs.	Are not replaced

Kind of Tooth	Location	Appear	Replaced
Incisors.....	Middle	Birth	2½ years.
	Center	4-6 wks.	3½
	Comer	6-9 mo.	4½

Up to four years of age the above table is of help in judging the age of horses. After that, other indications must be taken into consideration. At about six years of age the cups wear out of the center pair of incisors in the lower jaw. At about seven the cups wear out of the middle pair of incisors. At about eight years of age they wear out of the comer incisors.

At nine years the cups wear out of the central upper incisors of the middle pair and of the comer at twelve.

However, in judging the age of a horse by the wearing of its teeth several things must be taken into account. First, what kind of food, second, the structure of the teeth themselves, soft teeth wearing off much earlier than small hard teeth, the way the teeth meet, and others. The upper incisors are much less reliable than the lower as a means of indicating age. After twelve years the teeth are a poor indication of age.

Care of Horses, Shelter, Cleanliness, Ventilation, Feeding, Kinds of Food, Regularity of Feeding, Balanced Ration, Watering, Breaking, Harness, Essentials, of Good Horsemanship

Care of Horses

Perhaps the one great essential in the care of horses is proper grooming. Nothing adds so much to the beauty and luster of the coat as this. On reaching the stable the horse should be unharnessed, fed, given a thorough grooming and blanketed. The legs should be given a thorough and quick brushing. It is well for the farmer to remember that time spent on the horses at the end of the day's work is worth twice that time spent in the morning.

The teeth of a horse needs frequent attention also. If the milk teeth do not come out in the proper time, they should be pulled with forceps. As the permanent teeth wear the inside of the lower and the outside of the upper molars may become sharp, and irritate lips and tongue. If this condition exists, it should be remedied with a guarded rasp.

A horse should be clipped over the entire body. It not only improves the appearance of his coat, but also prevents his taking cold, since the animal does not get so warm. It also makes the horse easier to keep clean. If horses are not to be protected from cold and wet during the winter, they should not be clipped in the fall.

A good, liberal bed should be provided for the working horse. This should not be allowed to become dirty, since foul bedding lessens the rest of the animal and tends to produce disease. Old straw makes the ideal bedding, as it is dryer and more elastic. However, if straw is high, substitutes may be used.

Blankets for horses are indispensable in cold, wet weather. When a horse is very hot and sweating, he should not be blanketed until he has ceased to steam; otherwise the blanket will become wet, and remain so all night. In a quarter of an hour the horse should have cooled off, but during this time, he should not remain in a draft. In summer, blankets may be left off, if the stable is screened. The summer blanket should be of clean, light-weight material. Whenever the nights begin to get cool, if the heavy blanket is resumed, a heavy growth of hair will be prevented, and clipping may be unnecessary. If the horse is clipped, he should be very heavily covered for a while. The use of the outdoor blanket is even more important than the stable blanket. If one is going to stop but a short time, the temptation comes not to use the blanket, but in cold weather it is much safer to do so.

During all the active life of the horse the feet require frequent attention and care. Each evening after a horse returns from work, the sole of the foot should be examined and all dirt or other materials removed. A small hay hook with a sharpened point is good for this work. If the hoofs seem dry and brittle, they should be kept oiled with linseed or olive oil or some good hoof ointment. Horses confined to the stable should have their hoofs trimmed to prevent their growing out long. Shoeing should be done only by a competent horse shoer, and the shoe fitted to the hoof after it has become cooled. Sick horses often need rest and care rather than medicine and many veterinary bills may be saved by a little care and attention as to bedding, covering, and proper food. It is well, if medicine must be given, never to put it in food or water, unless it is tasteless and odorless.

Shelter, Cleanliness, Ventilation

There are several desirable ways of housing horses. Where means permit, there should be a separate horse barn. In addition to this, there may be a shed open on the south, which is usually sufficient to winter colts except in extreme weather. The main requirements for a horse barn is that it be dry, sanitary, and reasonably secure against cold winds. The quarters should be kept clean, and comfortable bedding provided. A coal tar disinfectant used occasionally is a wise precaution against lice or other parasites.

Feeding of Horses, Kinds of Food

It may be well to begin with the feeding of the young colt in discussing the question of feeding, as to the age of weaning the colt, conditions must decide. It is usual to wean them at five or six months of age. The colt may be fed grain or simply turned out on the grass, if it has been accustomed to grass. However, in the case of draft horses, feeding is advisable. Good, clean clover hay is usually liked, while timothy is commonly fed. Well cured alfalfa is one of the best, but if fed should be used in connection with timothy or corn fodder. Sheaf oats may be added for variety, but the colts should never be given an excess of dry feed. Oats, corn, and peas, ground, are suitable cereals. Bran and oil meal may be fed to supply protein and give variety. Silage and cottonseed meal are not suited to colts, but sliced carrots and sugar beets are good for them. Until the colt is two years old, not over one pound of grain per 100 pounds live weight should be given. Equally important are salt, good water, plenty of fresh air, and exercise for the young colt for the first year. Colts should be changed from dry feed to pasture gradually. For working horses there is a great variety of foods, but the one rule applies to all—it must be clean, wholesome, and sound. Many diseases may be traced to the feeding of moldy hay and grain. During the winter when not at work, less grain is necessary, but when spring work begins, the same animal will require less hay and more grain. Plenty of clean, fresh water is one of the greatest needs of the horse. It is the most fastidious of all animals about its drinking water, and will often go thirsty before it will drink dirty or tepid water. Three times a day is none too often to water horses, and if they are at work, oftener. When horses are at heavy work, the noon feed should be largely of grain. A drink after being fed is a kindly consideration at any time.

Regularity of Feeding

Regularity is one of the essentials in caring for horses. They learn to expect their feed in a certain order, and not only dissatisfaction but even digestive troubles are likely to result if this order is disregarded.

Balanced Ration

Oats, corn, and timothy hay are perhaps the standard rations for horses, but clover and alfalfa are also good and may be fed in varying amounts. Red clover hay on some farms furnishes the sole diet of horses during winter months. It makes little difference what roughage is fed, provided concentrates are fed that will balance up the diet. If legume hay is used, the concentrates

need not be high in protein, but if timothy, or corn stover, or other carbonaceous foods are feed, bran or oil meal should also be given. Oats are and have long been considered the ideal feed for horses of the light type, but for work or draft types, their value has perhaps been overestimated.

Corn is a good feed, but if fed in connection with corn stover or timothy, the feed contains too little protein. Then oats, bran, or oil meals may be added. These may be given in large quantities two or three times a week, or in small quantities daily . They may be fed dry or in mashes. Barley is fed in many stables, especially to breeding horses. Cottonseed meal is becoming more common as a feed but should be fed with caution, not over a pound or two a day. The carrot is perhaps the best root crop for the horse. Only a few should be given, two or three times a week. Salt should be provided in rock form and be procurable by the horse at all times.

The condition of the horse, the season, weather, and work performed are all important factors in deciding the question of feed. Hence, only suggestions rather than rules can be given here.

The Wolff-Lehman Standards may be taken as a fairly safe guide. Per 1000 pounds live weight at light work, the dry matter required will be 20 pounds, protein, 1.5; carbohydrates, 9.5; fat, .4. For medium work, 24 pounds dry matter, 2 protein, 11 carbohydrates, and .6 fat.

For heavy work, 26 pounds dry matter, 2.5 protein, 13.3 carbohydrates, and .8 fat.

Watering

Horses need a full and frequent supply of water but care should be used in giving it to them. He should never be watered if very warm, or if water is given, limit the quantity and do not have it too cold. Horses on dry feed require more water than if on pasture. The time to water is a disputed question, but most say water before a hay feed and after a grain feed.

Breaking of Horses

In breaking horses and especially in handling young colts, one of the first things that must be insisted upon is that the animal under no circumstances ever be scared. A reliable trainer never allows any one to chase or throw at a young colt. The use of the halter should be taught early, first by leading, then by driving. From the very beginning the young colt should be taught to be handled, but one should be careful in handling the ears, the flanks, and the backs of the fore legs, as these parts are very sensitive. Never catch a colt around the neck. In catching it one hand should be put under the neck, the other under the hams.

Colts caught in this way will let one walk up to them, while if caught around the neck, are often approached with difficulty. In training to the use of the halter, select an old one that has been used recently, preferably by the mother. But is should be strong. Never pull on the nose band. To do so may result in later deformed necks or face lines. In teaching the colt to lead he should be taken over familiar ground, as to the water trough and back. He should never be pulled along, but coaxed. In fact, the harder the man pulls forward, the harder the colt is apt to pull backward. However, if he refuses to follow by coaxing, take a small rope. Tie a ring to one end. Put this quietly over the colt's back just in front of the hips with the ring on the under side of the body, so that when the other end of the rope is put through the ring, the rope will be drawn tightly around the flanks. Pass the rope under the body between the fore legs, then through the halter ring. Pull gently on the halter, then if the colt shakes his head and refuses to move, pull gently on the rope. Don't hurry him, but give him time to get used to the notion, and he soon will follow without trouble.

The next lesson should be that of driving with the lines. At about two years of age, he should be trained to the use of the bit. This is perhaps one of the most important parts of his training, for should his mouth be ruined as a colt, it may result in imperfections never later overcome. A biting harness is valuable in accustoming the colt to the bit. When the harness is properly adjusted he should be turned into the familiar lot, and left to accustom himself to the new arrangement.

Harness

A colt should be trained from the first to stand still while being harnessed. One that is continually on the move is never more than half trained at best. When he has grown accustomed to the bit, he may be harnessed. Never use new harness the first time, but strong harness that has been used by horses the colt knows. It is best to put the harness on for the first time when the colt is tired. Let him smell of it if he wishes, then put it on him quietly—just as if he were an old horse. Never throw the harness on. It will do more to frighten him than anything else. Be sure the harness fits. Should it abrade the back or tail, a vicious horse may be the result. Then the colt may be hitched either single or double. Nothing more than mere suggestions can be given here, but the one invariable rule is gentleness and quietness in handling a colt. They are nervous and sensitive to a fault, and the trainer must inspire the colt with a sense of trustfulness and lack of harm or danger, and, above all, should the trainer remember that the chief future usefulness of the horse

will depend upon the training and treatment during the breaking period. Harness that is properly fitted and comfortable adds much to the efficiency of the horse. Many owners are thoughtlessly cruel to their horses by using poorly fitted harness and irritating bits. There are many bits on the markets many of which are intended and are useful only as punishment. For a tender mouth, a good sized leather or rubber covered straight bit is perhaps the best. The bit should fit the mouth and not be too long. Sometimes it is necessary to try several bits before a suitable one is found. Once that a horse has grown accustomed to a bit it is often difficult to get him accustomed to any other. The curb bit is often used on high stepping animals, but should never be used by anyone unfamiliar with it, or it may prove an instrument of torture to the animal. The chief rein should be properly adjusted. The day of the extreme checks has fortunately passed. The over check and the side check are the two most popular. The former was first intended for trotters, but has been also adopted for driving horses. By it the horse's head is held in such a position that he is unable to see the ground in front of him, and also lessens his efficiency at pulling. But the horse should always be reined slightly. Unless so reined, he is apt to grow careless in his gait, and to attempt to eat while standing. This allows the harness to slip down, and may lead to accidents.

Great care should be taken in fitting the collar. Every animal should have his own collar that has been properly adjusted. Breast harness is permissible only for light driving. Many hold that in importance to the collar and bit comes the crupper. This should be carefully fitted, since sores on the tail lessen the reliability of any horse.

The use of fly nets is advisable, but since they are expensive and require time in adjusting, many drivers have dispensed with them. However, if flies are very troublesome, some sort of protection may become necessary. Good canvass ones are not on the market at reasonable prices, and are very effectvie in protecting horses both from flies and sun. Before one leaves the subject of harness, it seems well to say a word in regard to the care of this part of the horse's equipment. It is most important that the harness be kept scrupulously clean at all times. This is especially true of the collar, saddle or crupper. These parts rest directly on the horse's skin, and unless they are kept free from dust and sweat, sores are apt to result. Every farmer knows how sore shoulders lessen the efficiency of his horses during the heavy work season.

Essentials of Good Horsemanship

Perhaps the one great essential of good horsemanship is a sympathetic knowledge and understanding of horses. No person who does not understand and like horses can ever succeed in handling them. The famous jockeys of all times have been small, but never nervous in temperment. Between them and their mounts there was an understanding little less than human. Horses are always shy of strangers, and resent familiarity on their part.

Some people are naturally timid around animals. This type will never make good horsemen. A horse soon learns his driver. Indeed, the horse more often knows his driver better than the driver knows his horse.

Another essential of good horsemanship is confidence—confidence not only in yourself but in your mount. A person who doubts his ability to handle a horse never handles him. He must know, and make the horse know, he is master.

Another essential is never frighten a horse. If he sees something strange, let him examine it until he satisfies his curiosity, for his interest at first in the strange object may be merely curiosity, not fear.

A horse should never be allowed to run away. Once this has happened one can never be sure when it may happen again.

Another essential is kindness. The horse is one of the most sensitive of animals, and re-acts very quickly to kind or harsh treatment. The Arabs have breed the most wonderful horses in the world with dispositions without equal in the world, but the Bedouin treated his horse as a member of his family. It slept with him in his tent. It shared his rugs, it ate from his hand, and he would sooner part with his right hand than with his horse. For this reason, the securing of Arabian horses for breeding purposes has presented difficulties met with in no other lines of animal buying.

SWINE OR HOGS

List Breeds of Swine in District; Characteristics of Each

We found there were two types of cattle—beef and dairy—and two types of horses—light and draft. We also find there are two types of hogs—lard and bacon, but for various reasons the latter is so little known that many people can justly claim that they never heard of it. The lard type is by far the more common throughout the United States, principally because corn is the chief feed for hogs in the United States, and as it is deficient in ash and protein, tends to produce fat rather than lean meat. For this reason it is often called the American type of hog. The bacon type is raised mainly in Denmark, Great Britain, and Canada.

The principle breeds of the lard type are: Poland-China, Berkshire, Chester White, Duroc-Jersey, and Hampshire. The Tamworth and Large Yorkshire are the two main breeds of the bacon type.

The lard hog is low and compact. Its body is wide and deep, with shoulders full but not coarse. The hind quarters are full and carried out straight to the tail. The flesh should be carried well down to the hock. The flesh should be heavy and evenly distributed over the whole body. Market conditions control the weight. The demand now is for lighter animals—those from 175 to 250 pounds bringing the best price.

The Poland China perhaps lead in number and favor in the United States at the present time. They are natives of our country. They are medium in size, black in color, and have drooping ears. It was developed in southern Ohio, in the Miami River valley. Several foreign breeds were used in grading up the original stock.

The Poland China hog is black with six white points—white on the face, tip of tail, and feet. The face is straight with medium length head. The body is broad and deep, back curved, and low rump. The legs are short and well formed hams.

The Berkshire hog perhaps is next in number. It is a native of England, is medium in size, black in color, and has short, erect ears. Its color and marking is similar to the Poland China—black with six white points. The head of the Berkshire is short and dish faced. In body, it lacks both the depth and width of the Poland China, but it has a level, straight back, and long, level rump. There is much less arch to the back of the Berkshire than to the Poland China.

The quality of the meat of the Berkshire is preferred by many to the Poland China since there is much less external fat, but far better "marbling."

The next in favor is perhaps the *Chester White*. This type is divided into three groups, each with somewhat different origin. They are: the original Chester White, Todd's Improved Chester White, and the Ohio Improved Chester White. The Chester White is a native of the United States. It is white, large in size, and has drooping ears. Its head is of medium length, with face straight. The large ears are drooping. The body has not the width or depth of the Poland China, but the back is straighter. The quality of its meat ranks between that of the Poland China and Berkshire.

The Duroc Jersey originated in the United States. It is medium in size, has drooping ears, and is red in color. Its origin is unknown, but perhaps owes its color at least to the Guinea breed brought from Africa, red hogs from Spain, or those from

Portugal. In many points it is very similar to the Poland China Its head is of medium length, somewhat dish faced, and ears drooping. The back is broad and deep, but straighter than that of the Poland China. Their meat is similar in flavor and quality, but where corn fed is too fat for foreign trade.

The Hampshire hog originated in America. It is black with white belt. Its ears are erect, and the body is medium in size. The breed is easily distinguished by a white belt which runs around the body at the girth. The head of the Hampshire is of good length, and the face straight. The ears are erect and bend somewhat forward. Its body lacks the length, breadth, and depth of the Poland China hog. It is held by its admirers that the meat of the Hampshire is unsurpassed in quality by that of any of the other lard type.

The two bacon types are known as the *Tamworth* and *Yorkshire*. They are both of British origin, and little known in the United States. The bacon type is very different from the lard type, having a longer body, longer legs, lighter in neck and shoulders, and less width of back. The charactertistic point is the spring of the ribs, giving great depth to the body. The color of the Tamworth varies from light to dark red. The Yorkshire is white.

Care of Swine

Most of the disease to which hogs are liable are due to carelessness or indifference in management of swine. Most hogs have lice or fleas. A hog whose vitality is drained by these vermin is much more likely to be susceptible to disease than one free from them.

One of the first things to be observed in beginning hog raising is the careful selection of a breed. One should consider the breeds raised around him, local conditions, and market demands before making his selection. All newly purchased hogs should be dipped in a coal tar disinfectant before being allowed the run of a pasture. This precaution may save much time, money, and trouble later.

Feeding Swine for Market

No farm animal will turn food into flesh as quickly as the hog. If healthy, no other farm animal is so easily cared for. It requires little shelter, and will eat anything.

There is one rule that never varies, and that is the larger and older the hog, the more food that is required to fatten it. There have been many experiments made as to preparing the foods for pigs, but at best, the results have been most contradictory, and show that conditions and food used have much to do with the efficiency.

Some advise that the feed should be ground, but this depends both upon the feed and the age of the animals. If corn is very hard and dry, it should be ground. With the small grains, such as peas, millet, and beans, it is best to grind it.

Some recommend soaking the grain. Others oppose it, saying that if soaked, hogs tend to eat it without chewing. However, if soaked, it is more palatable, and succulent.

Few now recommend cooking pig food. If cooked, the cooker should contain a variety of foods, as cereals, root crops, and the like. At about three weeks of age, young pigs will usually show indications of trying to root, or eat the mother's feed. They now should be given sweet, fresh milk about three times daily. Do not let the milk be sour, or trouble will result. A few days later, a gruel of bran and shorts may be given. Between seven and ten weeks is the best time to wean.

Hogs are usually fattened and marketed before they are one year old. If the hogs are to be marketed light, the fattening process will begin much earlier, than if heavy lard hogs are desired. Winter and summer feeding are quite different. Small droves usually fatten quickest. The hogs should be uniform in size, age, shape, and color.

Pigs should be put on full rations gradually. Their appetites should always be kept keen. They should be fed both mash and dry grain, if possible.

Meal and skim milk makes the ideal food. They make better and more rapid gains if they have access to green forage. It is more profitable if possible to cut and feed the forage, for this prevents their using up their flesh in rustling, and also supports more hogs on less pasture. Cool, fresh water and abundant shade are two very important factors in the summer fattening of hogs. Hogs cannot perspire, and therefore suffer much during the heat of summer. To avoid this, many feeders plan to sell by the first of July.

Winter feeding requires much different foods, and better results will be gained if roots, such as turnips, sugar beets, potatoes, artichokes, or even pumpkins are added for variety. Skim milk for succulence excels all else for winter feeding. Mashes, as used for summer feeding, are also good. Sweet, clean clover or alfalfa should be fed from a rack as dry forage.

Lots free from mud and dry quarters are especially desirable as winter quarters for hogs. If corn is fed, the quarters need not be as warm as if more succulent food is given.

Hog Houses

While the average hog does not need an upholstered cage, he will undoubtedly do better if properly housed. Plenty of

light and good ventilation are of prime importance in the pig house. It should be dry and well drained. There are two types of houses that are to be recommended—large house and individual houses or cots.

Large houses are apt to be expensive and hard to clean. They are also apt to be located where pasture is not readily accessible.

The individual hog house is to be recommended for several reasons. First, it is apt to be more sanitary since it may be readily moved from one place to another. It gives Mrs. Pig more privacy when she is raising her little Porkers, and in case of disease, it makes segregation of the animals an easy matter. As it can be constructed from odds and ends of lumber around the farm, its cost is slight.

Care and Management of Brood Sow and Pigs

Milk is the first food for the young pig, but by the time it is three or four weeks old, it should be having middlings, shelled corn, or cornmeal and skim milk. "Slop" should be fed early. This should be fresh, clean, and sweet. This should be fed the young pigs in a separate pen from the older pigs. They with the mother should have the run of pastures where they have clover, alfalfa, or other forage crops.

The great fattening food is corn, but as long as the young pigs depend on their mother for at least part of their feed, this need not be given in large quantities.

Mother and young pigs should be separated from the other swine, both because there is danger of the young one's becoming injured, and because the mother will take better care of the little ones if alone with them. They should have plenty of clean, fresh water, and plenty of shade in the summer. They should have a separate house to themselves, which is clean, airy, and well provided with bedding.

Diseases of Hogs and Treatment

As a rule, swine suffer from fewer diseases than any other farm animal, yet these diseases are more serious than those which the farmer has to treat in other animals. The three chief plagues of the swine raisers are: Cholera, swine plague, and tuberculosis.

The two former are much more virulent than the latter, and probably cause farmers and stockmen in the corn belt greater financial losses than any other disease known. All three are infectious diseases. Cleanliness and sanitation may do much to prevent the spread of these diseases. At present there are serums on the market that promise much in eradicating these evils, but their results have been more or less contradictory, so that some farmers are still depending more on prevention than

on cure. The Government from time to time issues bulletins on this subject, and swine raisers and breeders would do well to keep in touch with developments along these lines through these bulletins.

Cholera is a germ disease and the only precautions that need be taken are those that will keep the germ away from the herd. Every farm should have a quarantine lot, where animals that do not seem well should be placed and watched. Also all new stock purchased should be placed here under observation for at least six to eight weeks.

Tuberculosis is a more treacherous disease, and is often not discovered until the hog is slaughtered. Government examination made of all carcasses often reveals the presence of this disease when it was unknown before.

It is often best, if hogs are known to have tuberculosis in advanced stages to kill them and burn the body, rather than risk infecting others. In the case of valuable animals, a veterinary's advice should be secured.

A farmer may recognize hogs that are taking cholera by their actions and appearance. They refuse feed, lie in the shade, the hair becomes rough, the eyes red, and with a sticky discharge. There is usually a slight cough. The walk will be uncertain and the hind legs weak. The skin will become blotched and red, and if a post mortem is made, ulcers are usually found along the intestines. With cholera, an ounce of prevention is worth ten pounds of cure, and if cholera is in the neighborhood, notify the State authorities and ask to have the herd inoculated.

SHEEP

Study of Animal, Adult and Lamb

Like the horse and cow, the sheep is a mammalia. Like the cow, it also has a stomach containing four divisions.

Like the cow, the sheep chews a cud, like goats, chamois, muskoxen, cattle and antelopes, all of which belong to the family Bovidae. It is different from the others of its family in size and covering. It carries its head more erect, and its muzzle is narrow, covered with short hairs and divided by a verticle cleft. Owing to the mobility of its lips the sheep grazes much closer than the ox. Most modern breeds have no horns.

The wool varies in density from 600 to 1500 fibers per square inch in finess from 1/300 or more to 1/3300 of an inch in diameter. In length it varies from 12 months growth from less than 1 inch to more than 15 inches. The shortest wool is the finest and densest, usually grows in the region of the shoulders, about midway between top and bottom line of body. Coarse wool grows on outer thighs, the shortest on the belly.

Types of Sheep

The sheep is of two types—the mutton type, and the wool type. As their names indicate, the former is raised for its flesh, and the latter for the wool it will produce. The mutton type demands a full, plump body, while the wool type demands as much skin surface as possible, and in this type the skin is thrown into folds.

Type and Breeds in the Community

There are three wool type breeds in the United States. They are: American Merino, Delaine Merino, and Rambouillet.

The American Merino is really of Spanish origin, but since it has been so greatly improved in the United States, it is spoken of as a native of this country. It is white in color, its wool varies from two to three inches in length, while the fleece will weigh from 12-25 pounds. The animal itself will weigh 100-150 pounds. Its head is small, with white nose and ears. The ewes are hornless, but the rams have heavy twisted horns. The skin should be a bright pink in color. Along the head, breast, shoulders, and lower sides, thighs, and rump, it often lays in folds. It produces the finest wool of any sheep. This wool contains an excess of oil, often as much as 60 or 65 per cent of the total weight.

The Delaine Merino is also white and a native of the United States. Its wool varies from three to five inches in length, while the weight of the fleece is ten to twenty pounds, and the weight of the animal 100-150 pounds. Material spun from its wool is very durable, and has great strength. In a general way, this breed is similar to the American Merino. There are several families of the Delaines and they vary a good deal from each other, hence the Delaines cannot well be compared with any other breed without making statements that will be false to one or other of the families.

The Rambouillet is a native of France. It is white, with wool three to four inches in length. The animal weighs 150-185 pounds, while the fleece weighs 10-15 pounds.

The Rambouillet is somewhat larger than the American merino, and has a somewhat smoother body. It has also been criticised for a too great length of leg, and a coarseness of bone.

There are seven breeds of mutton sheep, all having their origin in England, except the Cheviot, which is claimed by Scotland.

The *Southdown* is gray in color, with rather a short wool two or three inches in length. The animal will weigh 125-175 pounds, while the fleece average four to eight pounds. It was the first of the mutton breeds to be improved, and has long been

the favorites of royalty. The head is of medium size and hornless, with the face well covered with wool. The neck is short and thick, shoulders full and broad, back straight, ribs well arched and long, hind quarters long, with a rump broad, square and full. The skin is a bright pink and the fleece should be compact, of medium length, and contain some oil. The wool is white.

The Shropshire breed is of obscure origin, but was developed and improved upon by Samuel Meire of recent date. The color of its points is dark brown. Its wool is three or four inches in length. The animal weighs 155-225 pounds, while the wool weighs eight to twelve pounds. It is one of the heaviest of the mutton breeds. Its head is hornless and is covered with wool almost to the end of the nose. It is usually taller than the Southdown.

In color, points and length of wool the *Hampshire* breed resembles the *Shropshire*. But it is larger in size, being from 180-250 pounds, with a fleece that weighs five to eight pounds. The early history of this breed is unknown, but marked improvement on it began in 1834, when William Humphrey, of Oak Ash, Newbury, England, began cross breeding with Southdowns. The Hampshire is larger and coarser than the Southdowns. The ears are large and drooping and the face and legs almost black.

The Oxford Down is one of the largest breeds of mutton sheep, weighing 200-325 pounds, with a fleece of six to ten pounds in weight. Its wool averages four to six inches in length, and the color of its points is brown. This breed is of comparative recent origin in the county of Oxford. It is larger and coarser than the Southdown, has a longer fleece, and darker points. It has a longer and coarser fleece than any other of the mutton breeds. The skin is somewhat bluish, with black spots, and sometimes hairs in the fleece. However, these objections are being rapidly overcome by careful breeding.

The Suffolk Down weighs 180-240 pounds, with a fleece weighing five to eight pounds. Its length of wool is three to five inches, while the color of its points is black. It is the result of cross breeding between the old Norfolk and the Southdown breeds. It is one of the most conspicuous examples of successful cross breeding found among sheep. It has a black face, clean, long, black legs, black ears, which are rather large, with a tendency to droop. While the Suffolk and Hampshire resemble each other, the former may be distinguished by the bareness of the head, which is usually quite free of wool.

The Dorset is a pure white sheep, weighing 150-225 pounds, fleece weighing six to nine pounds, and wool in length three or four inches. This is one of the oldest distinct breeds of sheep,

no other having been bred into it. Both male and females have horns. It is larger and longer of body and leg than the Southdown. The face and legs are pure white.

The Cheviot breed originated in the Cheviot hills separating England and Scotland. It weighs 150-225 pounds, with a fleece six to ten pounds in weight, and wool five to eight inches in length. The legs of this breed, as well as the face, are white and free of wool, while the body is closely covered with a long, soft, pure white wool. It is very hardy and active in temperament, being characteristically Scotch in this respect.

There are four breeds of sheep known as the long wool breeds of mutton sheep. They all originated in England, with the exception of the Black Faced Highland, which is a native of Scotland. These are: the Leicester, Cotswold, Lincoln and the Black Faced Highland.

The lenght of the wool varies from six to ten in the Leicester, eight to fourteen in the Cotswold, ten to eighteen in the Lincoln and eight to fourteen in the Black Faced Highland.

In weights they vary from 180-240 pounds in the Leicester to 200-265 in the Cotswold, and 275-350 in the Lincoln.

In the Leicester breed, the fleece is excellent for coarse wool, and lies in spiral locks all over the body. The face is covered with fine hairs, which are becoming soft and white.

The Cotswold resembles the Leicester, but is larger and has longer wool. The head is the distinguishing feature of the Cotswold, in that its has curls or locks which hang over the forehead, and often extend to the nostrils.

The Lincoln breed is the largest and longest fleeced breed of sheep in Britain.

The Black Faced Highland is a native of Scotland. It is the oldest breed of sheep in Britain, and little is known of its origin. Both male and female have horns. Those of the male are spiral, but those of the female are small, thin, and but slightly curved. Its fleece is long and coarse. The legs and face are black.

Value of Sheep

The value of the sheep on farms cannot be overestimated. In the first place, no other material can quite take the place of wool as clothing. Not only as garments, but for use all over the home, wool is unsurpassed as a fabric. Not only do sheep produce clothing material, but its flesh is vary palatable and nutritious. Since the sheep is usually freer of diseases than either the hog or cow, it is a more sanitary and safer meal than that of either of the above. Its chief value to the farmer is that sheep will thrive and do well on land too poor and barren

to be of any other use. Through the use of sheep great areas of semi-desert lands have been made of great economic importance.

The sheep requires about twice as much digestible organic matter per 100 pounds gain as the pig, but since much of the sheep's food is roughage, this stalk is to the sheep's advantage.

Characteristics of a Good Fleece

The five following points are the characteristics by which a good wool is judged.

1. The density of the wool or the number of fibers to the square inch.
2. The textile strength or the weight each can bear without breaking.
3. Its color and gloss.
4. Its elasticity or ability to curl up after being stretched.
5. The length when uncurled and stretched.

There are two general classes of wool—the combing grades, including the fine and short grades, and the carding wool that includes the long and coarse grades.

Merino wool is the chief wool on the American market, and is used in making all fine woolen clothes, yet the coarser grades are much used in materials requiring weight and strength.

Sheep Industry

High, dry lands are the ideal locations for raising sheep. However, they may be raised almost anywhere except on wet, swampy land. No one unless he has sufficient land to insure a change of grazing pastures can expect to find sheep raising very profitable. They do better on short, fine grasses than on coarse, high feed. However, if they are turned out to clean up brushy land—which they will do to certain extent—they need not be expected to produce a high grade of wool or good lambs. Grain feeding is scarcely profitable or necessary when one has good grazing lands. One hundred pounds per year is the maximum that is likely to prove profitable under any conditions for an ewe and her lambs. Roots and silage furnish cheap feed, and are especially valuable for ewes in the winter.

The main essentials of sheep barns are dryness and freedom from drafts. Sheep stand the cold well, except the young lambs. Protection from winter rains and snowfall is necessary. Sheep never thrive well in close, ill ventilated barns.

Woven wire, rails, or boards should be used as fencing.

While sheep require the least care of any farm animals, one should not make the mistake of thinking success can be made of sheep raising without giving time or work to it. The

wants of sheep are entirely different from those of any other farm animal and especially at lambing time, constant day and night care is often required to save both lambs and ewes.

Stubble and stalk fields form good fall sheep pasture, if fed before the fall rains. Later, clover and grass pasture may be used, when stubble and stalk fields are exhausted. A good field of blue grass is excellent where the winters are open. Green rye pastures in the fall are excellent as succulent feed. Sheep should never be allowed to lose in weight. A good test can be made by frequent examination of the bones along the back or loin. Cornstalks, straws, and the legume hays form a good winter feed. Cow-pea, clover, and alfalfa are good and may be used as the sole feed until a short time before lambing. Wheat and oat straw are better than barley and rye straw. Timothy hay is not recommended. Only silagé from good, mature corn should be fed. It must never be frozen, moldy, or spoilt. Not more than three pounds of this should be fed daily. One-fourth to one-half pound of cottonseed meal may be given daily, if pasture is soft and green.

Ewes should have plenty of exercise in the winter, but they should never be allowed to be chased by dogs. Their fleece must never be allowed to become rain soaked; if they do, pneumonia may result. Dry snow is not harmful, as they easily shake it off.

The lambing season is the harvest time for the shepherd, and contant care is demanded at this time. Much of his profits depend on the number and condition of the young lambs. In cold weather, the lambs must often be wrapped in hot blankets. Milk should be given freely. The lamb should be returned to its mother as soon as possible to keep her from disowning it.

The lambs should be docked when ten to fourteen days old. This adds much to the cleanliness and appearance of the sheep. It also raises its selling price on the market. Ewes should be watched to see that they are giving sufficient milk for their young.

Late spring or early summer is the best shearing time, though in some localities, sheep are sheared twice a year—both spring and fall. It should be done on a warm day, but before hot weather begins. Hand shears were formerly used but now hand power machines are coming into general use. They are more rapid, the ewes are injured less, and smoother, neater work is done than by the hand shears. Shortly after being shorn, the sheep should be dipped to free them from ticks, lice, and other skin diseases. The dipping should be done in the morning so the sheep will be dry by night.

If the lambs are to be sold at three to five months of age, they should run with their mother up to that time.

Stomach worms are one of the greatest menaces to the sheep raiser. These live in the fourth stomach. On farms where sheep have not been previously, they are not likely to prove dangerous until the second or third year.

Lambs should be ready for the market from three to five months of age. The sooner they can be marketed the better because the younger they are the cheaper they can be made gain. Young lambs should be taught to eat while young. A trough for grain and a rack for hay should be made accessible to the lambs. The food should be fresh, clean, and free from mold. When ten to sixteen days old, the lambs should begin to nibble at the grain.

Pea green alfalfa is one of the best early feeds. This should be of the second or third cutting. Sweet wheat brand is also good. Linseed meal is also good mixed with bran. Until the lambs are five or six weeks old, all their feed should be crushed, or coarse ground oil meal is usually relished, too. Cleanliness is one of the most necessary things in feeding young lambs. Any feed left uneaten should be removed and the trough occasionally scrubbed with lime water.

Raising lambs on pasture alone cannot be recommended usually. Unless the lambs have had some grain, they are usually very likely to suffer from stomach worms. They also make smaller gains in hot weather, and unless they have learned to eat, when the ewe's milk begins to be scanty, the young lambs will suffer accordingly.

The dry lot method has been tried by some breeders to escape stomach worms. By this plan, the sheep do not leave the lot until they are weaned, then they are put on clean, fresh pasture.

The practice of grazing sheep in forage crops until the lambs are marketed, is increasing, especially in sections where land is high and where stomach worms are troublesome. Wheat or rye, fall sown, are first used. Spring sown oats and peas are next used. Later the first ground is plowed and sown in cereal or to rape or soy beans for later use. This plan requires much more work, but produces the greater amount of feed from the same ground as well as minimizes the danger from worms.

In 1915 at the University of Illinois, three lots of ewes and lambs were reared under the three conditions of Dry Lot, Pasture with Grain, and Forage Feeding. The average weight from the dry lot method was 66.1 pounds with a ratio of net returns at 100 per cent. The pasture with grain fed lot averaged 64.4 pounds, with a ratio of net returns at 131.8 per cent. The forage lot averaged in weight 72.4 pounds, with net returns of 195.7 per cent.

WATER SUPPLY

The Drinking Water in the School and Homes

One of the most important questions to be decided upon around a home is the question of water supply. There are two general sources of water supply—*surface* waters and *underground* waters.

Surface waters may be divided into ponds and flowing streams. The use of these is largely confined to stock and laundry purposes. The water in flowing streams has it origin as all surface water in rainfall. If the source is drainage, it is perhaps too badly contaminated for domestic purposes.

The water flowing over surface of the soil will carry along with it in solution many impurities and soluble minerals from barn manure which renders its use distasteful. Surface water also comes in contact with many human wastes that renders its use dangerous. During some seasons of the year there is also much decaying vegetable matter that will render surface water dangerous. However, if such water flows for some distance through a stream of rocky or gravel sides, it may be purified till it is safe. The action of sun and air in purifying water is also remarkable. A stream that is fed by underground tile drains is more apt to be safe, since to reach the tile the water has filtered through several feet of ground. The nature of the soil will have much to do with the purification that has taken place. But tile-fed streams can usually be counted upon only a small portion of the year, since, during the dry months, they dry up.

In some localities ponds are depended upon to furnish water during the summer months for stock. In some cases, they are often relied upon for house use. Some ponds are formed by natural depression, others by a natural draw, and others have been scooped out to the depth of two to four feet. They are usually found where the soil is a heavy clay, thus holding the water till it is evaporated or used out. As long as it rains frequently and is cool, these ponds form a very good source of water supply for stock, but during the hot months when the water is low, and becomes stale, many forms of plant life develop which render the water unfit for animals of any kind.

Among *underground* waters, springs form one of the most satisfactory forms for farm use. Springs, so called, are of many kinds, but the term spring can really be applied only to that decided stream of water which emerges from the ground with a more or less constant flow.

Sometimes seepage veins are called streams, but these are really wet weather streams, and are dry most of the year. They are really the result of water running from a water-bearing

stratum over a somewhat large area. The flow from these is very irregular. At times is is well defined and strong, at others it may spread over a large area and result in a swampy condition. Again it may cease, and then break out in some other location. The nature of the waters of these springs varies with the kind of soil through which they flow. It is usually hard and contains iron.

An artesian spring is rarer and far, far more valuable than the former type. Its waters bubble up out of the earth, and if confined in a pipe, may rise to some height. As a general rule, the water of these springs is pure and very cold. If contaminated it is usually from the surface water. If it is contaminated it will become disturbed and show turbidity after heavy rains.

Springs whose waters are intended for human use, should be protected from surface wash, leaves, and other foreign material.

But the greater part of our water is secured from wells. As a rule, the water is pure. There are three types of wells—each of which will be discussed at some length. These are dug, driven and drilled wells.

But before continuing the discussion of wells, it may be of some use if one would consider for a minute the amount of water used around the home in one day. There is but one thing more necessary to man's existence and that is air. Until one is deprived of plenty of pure, clean water, he can never realize what a Heaven-sent gift it is. Civilization never reaches its greatest development in places where there is not an abundance of water. A great deal of our commercial, industrial, agricultural, educational, and civil life depends upon our water supply. If at first this seems an exaggeration, a moment's consideration will bear out the truth of the statement.

In planning on the water supply around the farm, home, or school, there should be a very definite idea as to what the demand will be. On the average a cow will require ten gallons per day, a horse twelve, a hog two, and a sheep one.

If a house has bathroom equipment, each person in the house will use on the average of twenty gallons per day, but if no such equipment is provided, eight to twelve gallons will prove to be a fair average. This, of course, includes water used for laundry purposes.

Many farm homes have, in addition to wells, cisterns, These are of great use to the farm wife, especially if the well water is hard, but are scarcely a safe or satisfactory source of drinking water, since the water is apt to have a characteristic color and odor. However, if they must be depended upon, careful construction and cleanliness may do much to remove these objections.

If the house roof is slate, tile or similar material, and is allowed to wash well before the rain water is turned into the cistern, the water may be kept in good condition. Adequate filters also should be provided. Cisterns are practical for home use, but are scarcely to be recommended for schoolhouses.

Like the school building themselves during the last ten years, the school water supply has undergone many changes. The old-time well and moss-grown bucket are a thing of the past. Wells of various types with concrete curbs and modern pumps have taken their place.

Children drink a great deal of water, and it should be pure, clean and cold.

Covered Receptacles; Drinking Cup and Drinking Fountain

Covered receptacles. If it is not possible to have a supply of drinking water in the home or school, covered receptacles should be used to keep a temporary supply. The best receptacle is a white granite bucket with close fitting granite lid or the china water cooler with faucet. Individual drinking cups are a necessity, indeed in most places are now required by law. These vary from china, porcelain, or the collapsable drinking cup to various types of paper cups. These may be the round paraffined cup or the collapsable envelope cup.

The drinking fountain is rapidly finding favor especially in large cities. It is impracticable unless attached to some large water system. They may be the constant flowing type or the foot or hand operated sort. To gain the desired results from a drinking fountain it should be used properly. Only the lips should touch the water. Remember, it isn't a bath tub, a dog fountain, or a wash tub. The hands, handkerchief, or no other article should be placed near the water. Children should not be allowed to play around it, trying to stop the flow with their hands, etc.

Wells; Kinds; Sources of Water in Each

There are three general types of wells—dug, drilled, and driven. The former was the original type and in the older sections of country is still the most common. This was true because a farmer and his helpers could dig it without special tools or expensive equipment. However, these wells are only practical where a good supply of water is found with fifty feet of the ground. This is the usual maximum depth for a dug well. The hole may vary from four to eight feet in diameter. In order that the cleaning of the well later may be accomplished more easily, it is better not to have the diameter too small. It is also desirable to have the well large enough to store a considerable amount of water, since these shallow wells do not usually strike

a heavy flow of water. In many cases dug wells do not strike any definite vein of water, but depend upon seepage water, hence a large storage chamber is very necessary. Again, very strong veins are struck, and the well may fill very rapidly. In case a slow vein is struck, in order to get an adequate supply it is sometimes necessary to dig until several such veins are encountered. A well may be walled up with brick or stone. It is done without mortar or cement. The top should be laid with cement mortar for at least eight feet below the surface. This prevents rats, mice, toads, and other vermin getting in and also shuts out surface wash. A concrete slab is the most desirable curb. This slab should be cemented down to the top of the well, and thus make the well proof against surface contamination.

The water in dug wells always comes from gravels, sands, clays, glacial drift, and similar loose formations of soil. It is usually of a mineral nature because in its course through the ground, it dissolves many minerals. Iron is nearly always found, as is calcium and magnesium. Such are rarely objectionable.

The drilled well is next in importance to the dug well, and in the newer regions is found very largely. It is well suited to all parts of the country, since it may be sunk in rocks of all kinds, and to the depth of thousands of feet if necessary. However, the average well is not over three hundred feet deep, An iron casing, five to eight inches in diameter, is usually used, but after rock is struck this casing is continued but a few feet further. The question of surface pollution is not a serious one with a drilled well, provided the top of the casing is properly protected. The water of drilled wells comes from the same sources as that of dug wells, as well as any of the rock formations, which usually furnish a supply of water. Sandstone and limestone furnish by far the greater part of our water supply. Sandstone is the chief of all rock formations as a water bearer. It gives up its water readily, and the water as a rule is not highly charged with minerals. The water from limestone is usually hard, but does not usually contain many other minerals. The water from limestone is much more apt to be impure than that from sandstone.

In concluding the subject of drilled wells, it may be well to point out a few of its drawbacks. It is usually expensive to drill, and it has little storage capacity, hence unless a strong vein is struck, is apt to be unreliable, the water stands in the pipes, hence is apt to have an iron taste. The pipes rust and corrode. Yet it is by far the most satisfactory of all wells. It is adapted to all regions, it may go ten feet or several thousand, it may be deepened at little expense, it can be located anywhere, and is little influenced by long, dry seasons.

Driven wells are usually found in regions where water is found within 50 or 75 feet of the surface. It is not suitable for regions where stones and such are apt to be encountered. In driving a well, a pipe of one and one-half inches in diameter is fitted with a special drive point. This is driven down until a strong flow of water is encountered. If the water is close to the surface, a common pitcher pump may be used, but if more than thirty feet below the surface, a three-inch pipe is used.

The water of such wells is usually pure, and is found in sands and gravels. There is no danger of surface seepage, and as sand is a good filter, the water is well washed before it goes into the pipes.

Artesian wells need scarcely to be mentioned here, since they are found only in limited areas. Sands and sandstones or glacial materials furnish many flowing wells. They are rarely found in limestone regions.

Experiment to show source of water in a shallow well, in deep, in drilled wells. A shallow well is a dug well ten to twenty feet deep and depends upon surface water for its supply. A liberal quantity of salt springled upon the ground around the well will show the source of water supply by an increased amount of chlorine there will be in the water.

Deep wells are of much the same sort as shallow wells, and may likewise be tested with salt or kerosene, but it must be kept in mind that a greater quantity is required, and a longer time allowed for penetration.

Drilled wells are but estensions of driven wells. These may be extended a hundred feet or even much deeper if necessary. Tests for the source of water in driven wells may be made with paraffin oil or a strong alkaline solution of fluorescin.

Use of analine dyes also is recommended, as is the use of the bacillus prodigiosus, the latter being employed only by one skilled in its culture and use.

Impurities in Water

Impurities in water may be of several kinds. Most well waters contain minerals. If these are from 20 to 100 grains per gallon we speak of the water as good, but if over 100 we call it "hard." This may become so great it is unfit for use. Water containing over 100 gr. of such salts per gal. as magnesium sudphate or sodium phosphate are known as mineral waters and taken for their medicinal effects.

Vegetable and mineral matter may cause impurities in water. Such contaminated water is liable to have a brownish color, unpleasant odor, or "off" taste.

Animal pollution is very objectionable and causes much impure water. If from human excrement such pollution is especially dangerous.

How to Secure Pure Water

The dug well should always be placed at the highest point of the surrounding ground. This is so that the surface wash will be away from rather than toward the well. The distance from cess pools, barns, outhouses, and such must vary with the nature of the soil. From fifty to one hundred feet is safe in heavy clay soil, sandy or loam soil, where seepage is very slow. This is especially true if the well is deep, and has a distinct vein, of heavy flow, and seepage water does not supply the source. If the well is shallow, and seepage water is the source, especially if the soil is of a loose, open nature, two hundred or even three hundred feet would be a far safer distance for the location of all objectionable out buildings.

Impure water is one of the many causes of sickness. If an epidemic of fever or such disease breaks out, the source of the water supply is at once looked into. In many cases it will be found to be contaminated.

Until Chicago and St. Louis looked into the question of the disposal of their sewage and the source of their water supply, frequent epidemics broke out, taking a great toll of life. Millions were spent by each city in assuring and uncontaminated water source. In St. Louis, the source is the Mississippi River. Great intake towers were built, and enormous settling basins constructed. The result is water that is clear and clean. Indianapolis faced the same question. The source of the water supply for this city was the White River, and filter beds were built to purify these waters. Chicago turned her sewage into the Illinois River, and thus prevented the contamination of the lake water, her source of water supply.

Throughout the length and breadth of our land today, people are awakening to the dangers of contaminated water.

Sewage Disposal

Sewage disposal around a farm is as important as anywhere else. Sewage consists of several classes. The least dangerous is the drains from bath tubs, wash basins, floor drains, etc. Human excrements on the other hand are rich in organic substances as are dairy wastes. These should be so treated as to insure rapid mineralization of the organic residues.

Septic tanks are one means of securing sanitation around a farm.

The activated Sludge method offers to the farmer a means of regaining the plant food from sewage. This circulates the sewage for several hours in circular tanks and the aerobic bacteria added under compressed air. The brown jelly-like mass which settles down is ground after drying and is rich as a fertilizer. No offensive odors arise. It is an ideal means of disposing of sewage but is expensive. All outbuildings should be kept as clean as possible, quantities of lime being used on refuse, much of which should be buried if no other means of disposal is at hand.

The Need of Water in the Human Body, Amount to Drink

One of the greatest uses of water in the human body is that it affords a medium for the solution of foods after and during digestion. Most of our foods contain water, fruit and milk containing the most. However, food does not supply as much as the body needs, hence we should drink plenty of pure water.

The quantity depends on the person, occupation, season of year, food, and general health. Naturally, a man working out in the heat in summer would need a great deal more than a student in the winter time. Water helps to carry off the wastes of the body as sweat or through the kidneys. It also serves to regulate the temperature of the body. Indeed it has been called the safety valve of the human boiler.

No definite amount can be set as the amount each person should drink daily. It has been declared unsafe to drink too much with our meals. The limit being drank two glasses. However it is safe to say that enough is not drunk between meals by the average person. A glass just before going to bed, and one on arising is especially recommended. A person can do without food longer than he can without water. Men can live days if trapped in mines provided they have plenty of good water.

Bathing

Not the least use of the human body for water is for bathing purposes. Some recommend cold baths in the morning others hot baths just before retiring. Again individual peculiarities must decide. If no after glow, but instead a feeling of depression follows a cold bath, they do more harm than good. A shower bath is the most sanitary. A daily tepid shower with a weekly hot scrub with soap will keep most of us fit, and with our bodies in a condition we need never be ashamed of.

Forms of Water—As a Liquid—As a Solid

As we all know, water may assume one of the three forms—vapor, liquid, or solid. In the vapor state, we call it steam, in the liquid, water, and in the solid, ice.

Water boils at the temperature of 100° Centigrade and steam is formed. If a glass of cold water is held in the steam arising from a boiling kettle, the steam is condensed, and gathers on the glass in the form of drops of water. Therefore, to condense steam, its temperature must be lowered. This same water may be converted into a solid by still further lowering its temperature to 1° Centigrade or 32° F., known as the freezing point.

NOTE.—*Teacher should have students point out various ways these three forms of water are met with in their daily life, and the various uses of each.*

We are apt to think of steam as the white spray like foam rising from boiling liquids. This is not steam. It is a vapor. The steam is an invisible elastic fluid generated from water by the applcation of heat. If we look very closely at the mouth of a boiling teakettle, we see nothing. About an inch beyond, we see what is commonly called steam. This is really the vapor caused by the condensation of steam. Anything that lowers the temperature of steam sufficiently causes it to vaporize, and as soon as vaporization begins evaporation takes place.

This is shown by holding a cold object in a spray of vapor.

Cooling Effects of Evaporation; Artificial Ice

One of the simplest experiments to show the cooling effects of evaporation, we have all unconsciously tried many times. This is to become so warm that we perspire. Then as the perspiration evaporates, our bodies are cooled. In order for a liquid to evaporate, it must assume a temperature somewhat lower than its surroundings.

To compare the value of liquids as cooling agents try this. Rub lightly the back of your hand with cold water. As it evaporates note how cool it feels. Now take alcohol and do the same thing. Note how much cooler your hand is and how much more quickly it vanishes. Now do the same with ether. The ether evaporates almost instantly and gives a very cold feeling to the skin.

This fact has been taken advantage of in our manufacture of artificial ice. As the ether or alcohol evaporates from our hand it absorbs heat hence cools our hand. In the same way, ammonia gas liquified is used to freeze ice. The gas is liquified under pressure, run through pipes surrounding tanks of brine. In this brine, tanks filled with distilled water are placed. This in from 36-48 hours is frozen as solid ice, and as such we use it in our ice chests, to make ice cream, etc. Made from distilled water as it is it is much purer than pond ice.

Regulation of Heat in the Human Body

The heat of the human body is regulated by the evaporation of perspiration. When we become too warm, instead of our temeprature rising, the sweat valves open, perspiration is poured out, and by its evaporation the body is cooled. In the case of the dog, which never sweats, the cooling is done by evaporation on its tongue. When the dog becomes too hot, he pants—that is—he thrusts out his tongue, and his body heat is cooled by the evaporation from its surface.

Heat of Vaporization; How a Steam Radiator is Heated

The heat of vaporization depends upon the temperature of the air into which steam is forced. Any temperature unless the air has reached the point of saturation lower than that of the steam will cause vaporization. As to the amount of heat necessary to raise any liquid into a vapor depends on the liquid. This for any particular substance is called its heat of vaporization and means the amount of heat required to change 1 gram of the liquid into vapor without changing its temperature. In the case of water it is found that 539 calories are required to so change 1 gram. The heat of vaporization of water is therefore 539 calories per gram.

In a steam radiator the hot steam is forced from the boiler through the pipes into the radiator. This being cooler than the steam causes the steam to vaporize, thus to give up some of its heat. This heat warms the radiator, and is the reason that when the steam is first turned into the cold pipes, they are apt to drip water.

Water Vapor in the Air; Sources: Rain

At any temperature a certain amount of water vapor can exist in the air. The cooler the air, the less vapor it can contain, hence our heavy dews at night. The warm moist air of the day when cooled at night cannot hold so much moisture and gives it up at night in the form of dew. Fog or mist is merely dew collected on soot or dust particles. Frost is produced if the temperature of the atmosphere reaches the freezing point before saturation occurs.

Warm air may contain much more moisture than cold air yet seems dry because it is not near the saturation point. A measure to determine the moisture in the air is called a Hygrometry.

Moisture in the air comes in the main from large bodies of water. In general its comes from any exposed surface of water. This is equalized by rains and dews. The sun heats the surface of the water, and thus hastens the process of evaporation. This

is also hastened by high winds. In the first case the sun by its heat causes molecules of water to escape from the surface of the water, the wind prevents their return.

Clouds are caused by the condensation of vapor in the upper strata of the atmosphere. As the heated air rises moist but not at the saturation point, it cools and expands and the moisture condenses to a mist or cloud when it has reached such a high altitude that it reaches the saturation point. This is the formation of our rain clouds. The rain descending makes up for the loss of the water in the streams and oceans.

THIRD QUARTER

HEAT, AIR, LIGHT

HEATING PLANTS OF THE HOME AND SCHOOL

Air Currents in the Room, Sources of Heat

There are various sorts of heating plants now in use in homes and schools. There are furnaces—hot air, steam, hot water, or various types of stoves. These will all be discussed in following topics.

How well a room is heated, depends upon the air currents in a room. For this reason, the hot air furnace with its cold air pipe is usually a satisfactory means. In a way, we can speak of air currents being the source of our heat. To air currents is due the supply of oxygen which causes the fuel to burn, and to them likewise is due the distribution of the heat produced by the combustion of the fuel. Open a window on a cold day, and note the cold air that rushes in at the bottom and the warm air that goes out at the top. This shows the direction of air currents in a room. In general, it may be said that in any room the rising currents of air are the warm ones, and the falling, the cold ones. So much depends upon the ventilation, and heating of the room, and other features, that no specific discussion is possible for rooms in general.

Parts of Jacketed Stove; Furnace; Steam Heater; Registers; Radiators

The open fire place is at once the best and the most inexpensive way of heating a room. It is the best way because it furnishes not only heat but also ventilation. In the early days this was the common means of heating schoolhouses, but it was wasteful of fuel and required much care. But for these reasons it has almost vanished from homes and schoolhouses. But of 1,296 rural schools reporting to the United States Bureau of Education from nineteen States, but one reported an open fireplace as a means of heating. However, the open fireplace as a means of heating a room has many advantages. It is cheery; it furnishes a place to dry damp clothing. It creates a circulation of air, and is an excellent means of ventilation.

About one-half of the small town and rural schools are still heated by the box stove, usually placed in the center of the room. This is one of the worst possible means of heating, for in severe weather, those who sit near the stove are much too warm, while those in the far parts of the room are cold. Some relief may be obtained by keeping a pan of water on top of the stove. This tends to add moisture to the air. This means of heating schoolrooms should cease, as there are many better means available now.

The jacketed stove is a step upward in the heating line. Any ordinary stove may be changed into a jacketed stove at very little expense. To do this the stove must be moved to one corner of the room, inclosing it all except the door, with a sheet iron casing, set six or eight inches from the stove. This space must be connected with the outside air by means of a carefully constructed fresh air duct. The jacket must fit closely to the floor and around the stove door, and extend above the top of the stove several inches.

As the stove heats the air it will become warm and lighter, and rise rapidly over the room. Then the fresh air from the outside rushes in and takes its place. A little study of the various types of jacketed stoves now on the market will show their advantages over the old-time box stove. Not only is the warm air more evenly distributed by this means, but also a supply of clean, pure air is furnished. However, their effectiveness as ventilators vary with the weather—being much more effective in severe than in mild weather. They are expensive to begin with but are to be recommended in all schools where furnace heat is not possible. They are far more common in the North than in the South. About one-third of our rural schools are supplied with them.

The hot air furnace is on the same principle as the jacketed stove. However, it has these advantages. It is in the basement, will heat a greater number of rooms, and is much cleaner than any type of stove.

The hot air furnace is a great aid in securing ventilation in cold weather. It is the cheapest of all central methods of heating to install. It requires less skill to manage than either a hot water or steam furnace. It is better suited to mild weather, where a little heat is needed during the morning and none at mid-day. It requires no attention when not in use, as there are no boilers or pipes to drain. One can add moisture to the air very easily by keeping the water pans of the furnace filled.

However, there are various disadvantages that may arise from the use of a hot air furnace. Most of these are caused by the furnace not being properly installed or properly tended.

Low pressure steam as a means of heating large school buildings has come into general use in very cold climates in the past decade. This means has many advantages in heating large rooms and buildings, but in general is not practicable in the one room schoolhouse. The boiler room may be in a separate building and the one set of boilers may be used to heat several buildings. The heat furnished is a comparatively steady heat, and may either be furnished direct to radiators in the room, or fresh air may be warmed and then conducted to the rooms. In general, it is more economical than the hot air furnace, but it requires skilled engineers to operate the boilers successfully. It is not especially well suited to mild climates, as it heats up slowly and cools off also slowly. It requires constant care, even when not in use. Hammering noises are often a nuisance in the schoolrooms, where radiators are used, and the danger of breaks and leakage is great. Steam heating apparatus requires more care than almost any other sort, unless it is hot water. The repairs on it are usually expensive, and there is more or less danger attached to its use, owing to the confined steam.

The systems of hot water heating correspond in many ways to steam. They are better suited, however, to mild climates since the water need not be heated to such a degree to start circulation as the steam system requires.

Registers are used with hot air furnaces, and are merely the opening of the pipe which conducts the hot air from the furnace into any room. Sometimes they are set in the floor, again they may be placed in the wall. They are often of wood formed into a sort of grating. Those in the wall ars usually of metal, and provided with a sort of damper which may be opened or closed at will.

Radiators are the series of coils or pipes placed in a room for heating it when steam or hot water is the means used.

Heat of Vaporization

We have seen that a liquid does not need to boil in order to vaporize. The boiling point of water is 100° C. or 212° F. at ocean level, but when pressure is removed it boils at less. Water in Denver boils at 95° C., and on Mt. Blanc at 84° C. But water will vaporize at any temperature. The lower the temperature the slower will be the vaporization. Even ice and snow vaporize before they melt. We can prove this by laying a square cut bock out in freezing weather. After a few days,, even though freezing temperature has been maintained it will be found to have lost its sharp corners and edges. This is the result of vaporization. No definite temperature can be set as the heat of vaporization.

Experiments to Show Convection Currents

We all know that air when heated becomes lighter. For this reason the temperature of any room if taken at both ceiling and floor will be found to be much warmer at the top than at the bottom of the room. Since it is difficult if not impossible to see the heat waves radiating and rising from the heated stove, put a shallow pan of water on the top of the stove. As it begins to boil, notice how the steam rises, often to some distance above the stove before it begins to disperse throughout the air. The hotter the steam and the denser it is, the higher it will rise before spreading out. As long as it is much hotter than the surrounding air, just so long will it continue to rise.

Or if one wishes to note how cold air quickly settles down, let him some cold day open a window both at the top and at the bottom, when the room is very warm. If the hand is held at the top of the opened window, he can feel the warm air rushing out, while the fact that one's feet soon become thoroughly chilled, proves that the cold air is rushing in and forcing upward the warm, light air.

Convection Currents in Chimneys; Convection Currents and Wind Convection in the Hot Air Furnace

Heat may be desiminated in three ways—by conduction, convection, and radiation. When we put a metal spoon in a kettle of boiling jelly, the handle becomes hot. This is heating by conduction. When we set a pan of water on the stove it heats, this is by convection. When we stand before a fireplace, we are warmed by radiation, or radiant heat.

Hot air and hot water heating are both applications of the convection principle of heating.

Hot air heating is quite common in small buildings. It consists of an air chamber above the fire box. As the air is warmed, convection currents are caused in the various pipes leading from the air chamber to the different rooms. As the air is cooled it is returned to the air chamber by the cold air pipe. In this it is also mixed with fresh outside air. If no cold air pipe is employed a great deal of the hot air will be carried out of the chimney and thus its heat lost. Unless the damper is closed after the fire is started, a great deal of heat will escape up the chimney anyway. This is also caused by convection currents.

Fuel—Kinds

Fuels are substances used to produce heat. To be a satisfactory fuel a substance must unite under proper conditions readily with oxygen. Hence the compounds of carbon—gases,

liquids, or solids—make the best fuel. There are two general classes of fuel—those we can term pure, or nearly pure, and the impure. The latter class are solids and include soft coal, wood, and peat. The pure, or nearly pure class includes gases, liquids and solids. The solids are anthracite or hard coal, coke, and charcoal. The gases are hydrogen, carbon, and hydrocarbons. The liquids are alcohols and dydrocarbons.

Wood was probably the first fuel used by man. The use of soft coal was first used during the 15th century while gas and hard coal did not come into use till the beginning of the 19th. Hydrocarbons as gasoline and kerosene and certain artificial gases were not used as fuel till the middle of the 19th century while the use of alcohol is now being developed. Natural gas is used largely in some localities for lighting and heating purposes. Petroleum is a dark oily liquid obtained from oil wells. It is a hydrocarbon, and is refined before using in most ways.

The Process of Burning

Burning is such a common sight, that it no longer causes us any surprise, yet it really is a chemical process where definite things occur ending in definite results. Suppose we put a lump of coal on the fire. The hot coals heat up the coal until it reaches the burning or combustion point. Then the chemical action begins. The carbon in the coal unites with the oxygen in the air. The coal is consumed, reduced to ashes, heat is released, and carbondioxide results. By the action of the heat, the coal has been reduced to its elements, and energy in the form of heat has been released.

Radiant Heat

It is a well known fact of physics that all objects give off heat. Even cold objects give off heat even though in a very slight degree. If an object gives off more heat than it receives or takes back, its temperature is lowered and it grows cold, but if it receives more than it gives off, it becomes hot. We often speak of the radiant heat of the sun, but the radinat heat of any article is just as much a fact as that of the sun except in a much less degree. It is owing to the principle of radiant heat that we are able to cook by means of heat.

The Fireless Cooker

The fireless cooker is a good example of radiant heat, being turned back upon itself, and thus used again. The article to be cooked is heated to the desired temperature, then put in the fireless cooker, where the cooking is finished. The principle is this: Surrounding the vessel is a layer of some non-conductive

material, as cork or asbestos. When the radiant heat of the vessel containing the food comes in conduct with this non-conductor, the heat is turned back to the vessel, and the cooking temperature is maintained.

The Refrigerator

The refrigerator is built upon much the same principle as the fireless cooker, except in this case, heat is to be kept out, and cold kept in. This is done by the same means—the use of a non-conducting material. The better the refrigerator, the lower will be the temperature maintained.

The thermos bottle which is now found in most homes, is constructed on an entirely different principle. It is based on the fact that heat or cold must have some conducting medium, either of material or air. To prevent this, the thermos bottle is really made of two bottles, one hanging inside but not touching the other. The temperature of the inner bottle cannot pass to the outer bottle because of the vacuum which has been made between the two bottles. The lining of the outer bottle is mirror-like, and this reflects the heat or cold back to the original bottle, thus maintaining a low temperature or high temperature, as the case may be.

The Ice Cream Freezer

The ice cream freezer is built upon the principle that by taking heat away from a substance, the temperature of the substance may be lowered to the freezing point. The heat from the mixture is radiated more rapidly than it is taken back, hence the result is a freezing temperature.

This discussion of heat and heating can be made but little more than suggestive here. If possible, the teacher should have the class perform experiments to show conduction, convection, and radiation. A good experiment to show convection may be performed by having a bottle of concentrated ammonia and another of concentrated hydrochloric acid. Hold them close together, uncork both bottles, and when the fumes from the open bottles arise, and mingles, a smoke will be formed, showing the path through the air, taken by the united fumes.

Great care must be exercised in handling the acid, as its action on clothing or flesh is very disastrous. By performing this experiment near the cold or hot air pipes of a hot air furnace, one may test whether the furnace is in good working order or not.

Pupils should be encouraged to read further on the subject in elementary books on Physics and scientific papers.

Measuring Temperature, the Thermometer

The temperature of any article is the amount of measureable heat it contains. The means of measuring this heat is the thermometer, phrometer or calorimeter.

The termometer is used for measuring heat in the air, water, etc. It consists of a tube with a capillary bore, and a bulb at the end which contains mercury or quicksilver. By the side of the tube is the scale, marked into degrees, where we may read the temperatures. To fill this bulb and then seal it so that all air is removed and excluded requires exact work.

There are three methods of graduating the thermometer, Fahrenheit's, Centigrade, or Reaumur's. The former is in general use in the United States, the second in France, and in most scientific work, and the later in Germany.

Oxidation

Oxidation is a chemical act. Rust on iron is the result of oxidation. The oxygen of the air unites with the iron and forms oxide of iron (rust). The green tinge we see on copper exposed to the air is oxide of copper or verdigris. The same sort of chemical process takes place when coal is heated to a given temperature. It then unites with the oxygen in the air and forms certain gases. What these gases are depend upon the chemical composition of the coal used. We all know how little dirt or smoke there is in a good grade of hard coal.

Light carbureted hydrogen, heavy carbureted hydrogen, carbonic acid gas, carbonic oxide, etc., are all produced when coal is burned. These uniting with oxygen of the air, produce heat.

Conductors of Heat

By conduction we mean the transmission of heat, electricity or the like by means of a substance or body capable of readily transmitting such forces. Heat, we speak of, as being conducted, given off by radiation, or transmitted by convection. A very common example of conduction of heat is that shown by a spoon left in boiling liquid. While the bowl of the spoon alone may be immersed, the handle will soon be so hot it can not be touched by the bare hand. The conductivity of various substances differs greatly. Wood is a very poor conductor, hence wooden handles are used on many kitchen utensils. Iron and steel are excellent conductors, while aluminum is poor. Some substances may be a good conductor of heat, but a poor conductor of electricity, as rubber, and vice versa. Some substances are such poor conductors, they are insulators, or non-conductors.

Asbestos is a non-conductor of heat, while rubber is a non-conductor of electricity.

Most metals are good conductors. While earth, sawdust, ashes, stone, glass, chalk, are poor. Silver is one of the best conductors. Ranking it 100%, copper is 74, gold 53, iron 12, lead 9, bismuth 2.

AIR

What Air is; Different Gases in Air; Proportion of Each

Air consists of a mixture of oxygen and nitrogen in a practically constant ratio, together with a small amount of other gases, and with a very variable amount of aqueous vapor. It was not until the middle of the last century that Prestley discovered that air was a mixture of oxygen and nitrogen. The proportion by volume is 21 of oxygen to 79 of nitrogen, and by weight 23 of oxygen to 77 of nitrogen. The other constituents of air are carbonic acid, which occupies three-ten-thousandths by volume, traces of ammonia, ozone, and argon, an element recently discovered.

Oxygen is the active vitalizing principle in air, that which makes human life possible. The proportions of oxygen and nitrogen vary but little whatever the altitude, being practically the same on mountains as at sea level. The difference in mountain air is due to its density and temperature.

The nitrogen in the air represents the negative element, which lessens the activity and energy developed by the combustion of the oxygen. In this way it tends to prolong life, because in pure oxygen life would be used up too rapidly. Nitrogen is less dense than oxygen, hence renders the air better suited to carry sound and sight.

Dust is another constituent of air which is found universally, though the particles are less numerous over the ocean and over mountains at high altitudes.

Experiment to Show that Air has Weight and Pressure

We are very apt to think of air as having no weight, therefore it will surprise us to learn how much air really weighs. It takes but 12 cubic feet of air to weigh a pound. At this rate a single large room will contain more air than a man can lift. The air in a room 60-30-15, the size of many church auditoriums, will weigh more than a ton.

To prove that air has weight, take an electric light bulb, weight it on a pair of delicate scales, then puncture the glass with a blowpipe and weigh again. It will be found to have gained slightly in weight after the air was allowed to enter. Or take a

light rubber membrane and stretch it over the top of an open jar. If the air is exhausted from the jar, the rubber membrane will break, crushed in by the weight of air pressing on it from above. The last experiment shows both that air has weight and pressure. Or take a light weight tin can. Close it completely and exhaust the air from it. The pressure of the outside air will cause it to collapse.

Measuring Pressure, The Barometer

Galileo, an Italian nobleman, who lived 1564-1642 was the first who attempted to measure air pressure. But he died before his experiments were successful. Torricelli his pupil, continued his experiments, and made our first barometer, or measure for air pressure. He took a tube about 4 feet long sealed at one end, completely filled it with mercury. This he closed with his finger, and put the open end, on which his finger rested, in a dish of mercury. When the finger is removed the mercury will fall in the tube leaving a vacuum in the closed end. It will fall until it stands between 29 and 30 inches above the mercury in the dish. When he placed the dish of mercury under glass and exhausted the air from above the dish, the mercury fell in the tube, when the air was admitted again the mercury rose, showing that the rise and fall of the mercury depended upon the pressure exerted by the air on the open mercury. By comparing the pressure or weight of the mercury with the height it remained in the tube, he demonstrated the fact that the pressure of the atmosphere is about fifteen pounds per square inch.

Our modern barometer is nothing more or less than Torricelli's tube, with a graduated scale at its side to show how the height of the mercury varies. This height varies from 73 to 76.5 centimeters in localities which are about sea level.

Moisture or Water Vapor in the Air

We all know that there is a certain amount of moisture in the air. When it is less than 40, we become uncomfortable, for the air dries out the moisture from our skin. When the humidity is more than 60, we are also uncomfortable, for the air does not evaporate enough, and we say the air has a hot sticky feel. Warm air has a greater capacity for moisture than cold air. Hence when cold air enters a furnace is warmed, the moisture has not changed, but as the air is warm, it takes up more moisture than it did before. Hence, in connection with our hot air furnaces, we should have some means of adding moisture to the air.

This topic has already been discussed under Forms of Water in the Second Quarter.

Air Pressure and Pumps—Other Work Done by Air, Vacuum Cleaner, Wind Mills

Pumps depend on the suction of air for their operation. The air is drawn up through the pump proper by working the handle up and down. As the air is exhausted, the water from below is drawn up, and as long as the pumping is kept up, a steady flow is maintained. Chain pumps, bucket, and pitcher pumps, as well as piston, and all forms of suction pumps are constructed on the same principle.

Vacuum Cleaners and Wind Mills

There are so many kinds of vacuum cleaners now on the market it is impossible to describe them except in a general way. They are both electric and hand power. Both work on the same principle, however. A vacuum is created by means of a motor or bellows. Suction is produced strong enough to carry the dirt along with the air current. The dust is conducted through openings into boxes or tubes, or bags, from which it may be removed at the operators' convenience.

The chief use of wind mills now is in the operation of pumps. Wind is the motive power, and for this reason it is one of the most economical machines on the farm, but is of limited use. It should be found on all farms, since in cost it is in reach of every one. In construction it is too well known to need description. Since the wind is an uncertain element, sufficient water should be kept stored to last at least three days. Besides being used to pump water, the wind mill to a limited extent has been used to grind feed, and to run various machines. The wind mill requires little care aside from frequent oiling and tightening of the nuts. What is true of the average pump, holds good for pumps used in connection with wind mills. At present wind mills are mostly employed in pumping water for storage or irrigation. They are found in the greatest numbers in the middle United States and in Australia. There are more than a million in the central part of the United States.

A geared wheel, twenty feet in diameter, will furnish five horse power in an eighteen mile an hour wind.

Air and Health—Dust in the Air; Dead Dust; Living Dust; Disease Bacteria

We must have good pure air in order to have good health.

We have all seen dust in the air. Any afternoon when the sun is shining very brightly into a room in a single straight ray, we can see the dust particles.

All dust may be divided into dead or living dust. The former is harmless or comparatively so, but the latter is not apt

to be. Dead dust consists of various things, usually bits of earth ground to a powder, particles of clothing worn by friction into very tiny pieces, pollen from flowers, dandruff, innumerable things in fact. Aside from irritating the membrane of the respiratory organs, dead dust is usually harmless. Among the live and therefore dangerous dust, we find the bacteria. Some bacteria as we know are harmless, hence should not be put in the dangerous class. These bacteria are the ones that give flavor to cheese, make vinegar, etc. When the bacteria are of the nature that cause food to rot, milk to sour, etc., they become harmful agents. But the most dangerous agents are those that cause human diseases. These are known as disease germs. Such diseases as typhoid fever, diphtheria, tuberculosis, and many others are the result of such bacteria. These germs are often dust borne and therefore all food intended for human consumption should be protected from the air.

Bacteria are very tiny, some much tinier than others. If we would magnify the point of a very, very fine needle, and some bacteria that produce diseases, in the same proportion, we would find the needle to look like a large lead pencil, while the bacteria would seem to be *very* fine dots, much smaller than a very small period mark. If these bacteria were magnified still more we would find that those that cause typhoid fever looked like broken pieces of string beans. Those that cause boils were smaller and nearer round; those that produce tuberculosis looked like black marks, one crossing the other; those that cause the la grippe were much like the typhoid bacteria but much smaller.

In 1882 Robert Koch invented gelatine and agar culture media whereby germs could be cultivated, separated, and studied under the microscope.

The best way to destroy disease germs is by keeping things clean. Soap and hot water are the best possible disinfectants, as are sunlight and air. Heat, either dry or moist, is also a good means of disinfecting or sterilizing any article. Unslacked lime, carbolic acid, chloride of lime, sulphur, mercuric chloride, and formaldehyde are excellent disinfectants, among the chemicals.

Ventilation of Home and School; How Secured

The subject of ventilation is one that has received so much discussion during the last decade, that little need be said here. In houses supplied with a hot air furnace, the ventilation is to a great extent taken care of by the furnace. Some buildings are equipped with special ventilating systems, more or less perfect. However, one need not resort to these, in order to have pure air. Windows opened at the top afford a simple means of ventilation. Bed room windows should remain open during the

entire year. Transoms are efficient means of securing good ventilation. Recess periods and noon hour afford opportunities to ventilate schoolrooms. A teacher, however efficient, is not doing her full duty by her students who does not see that the air of the schoolroom is kept pure. If necessary to open windows for a few minutes during school hours, give the students a brisk bit of calisthenics.

Source and Provision of Fresh Air in School. Relate to Convection Current Under Heating

One of the greatest problems architects have had to solve is the problem of supplying warm moist air to school children.

During the months of the year that the climate permit the windows to be open, there is no problem, but with cold winds and inclement weather the problem is a real one. Most efficient methods take into consideration the heating plant for when a room is heated by a stove or furnace, convection currents are set up that cause the air to circulate. This by no means solves the problem. To make the system anyways near satisfactory the air that circulates must not be only warm, but fresh and moist. To secure these things an abundance of outside air must be assured, then some way provided to add moisture, for the outside air when heated has an added attraction for water, and will as we say "dry out" whatever it touches. Various forms of appliances have been contrived to prevent this. Any that is satisfactory provides for fresh air being brought in from the outside, carried over the furnace, and then moistened. Fans, in some systems, are used to suck the foul air out of rooms. This creates a vacuum, which fresh air rushes in to fill. The more satisfactory fan system is the fan which forces fresh air into the room and drives out the foul by pressure. These fans are usually located in the basement. Appliances for moistening the air have not been altogether satisfactory as yet. Most of them are very expensive to run. The most successful are those that mix a steam spray with the air being forced into the room by the fans. But this means a great loss of heat and high fuel costs. The chief failure in most schemes is that they fail to make the air take up moisture fast enough as it circulates through or over the damp appliance.

Air in the Human Body—Air Pressure and Breathing, Oxygen in the Blood; in the Cells

As we all know the air is made up of oxygen and hydrogen. If the living body be analyzed we find the proportion of oxygen to be 72% and of hydrogen 9.1%. Carbon constitutes 13.2% and nitrogen 2.5%. The rest of the elements are less than 1% each. When we inhale air it contains about 20% oxygen, and when we

breathe it out, it contains about 16%, showing that the blood in the lungs has taken up about 4% of the oxygen contained in the air. The oxygen is taken from the air in the lungs by the blood which is flowing through the tiny network of veins in the lungs. The oxygen readily passes through the walls of these veins and combines with the haemoglobin or red coloring matter of the blood.

The lungs are constructed of epithelial cells of various kinds and of blood vessels. The air cells are so arranged that they permit the air to come readily into contact with the blood. The wall of an air cell consists of elastic connective tissue lined with a layer of thin flat epithelial cells. It is in this part of the lung that the exchange of gases take place. The dust breathed into the cells is removed by the action of the cilia which literally fan the obstructions back to the larnyx where it is caught up.

Most of us think we draw in the air when we breathe. This is far from the truth. We have already seen how the air has weight and exerts pressure. What really takes place when we breathe is that as the muscles of the chest expand the lungs increase in size just as a wet sponge squeezed in our hand expands when we open the hand. As the lungs expand the air, because of its pressure, is forced into the vacuum in our lungs. Thus we see how soon we would die if the air ceased to have pressure, and the reason we cannot live high up in the air, where the pressure is low.

Need of Moisture in the Air

The amount of moisture in the air we breathe varies. On a rainy day it is much more than on a dry hot day. But unless some moisture is contained in the air, we are uncomfortable. For the lining of the lungs is a delicate moist membrane and dry air causes it to lose too much of its moisture. We all know how dry and parched our mouth and nose feel after we have had a long walk on a hot day in the sun. It is nature's way of calling for moisture. But the only need of moisture in the air is not because of the nose or lungs. The skin also does its part in ridding the body of wastes. If the air in the room is too dry, our skin feels parched. Because of the lack of moisture we require a higher temperature to be comfortable. A temperature of 70° in moist air will give a sense of warmth that 80° in dry air cannot give.

Tests given recently by a heating commission proved that moisture was quite as necessary as a supply of fresh air to the well being and comfort of those it surrounded.

Weather—Meaning of the Term Weather

By the term weather we mean the condition of the atmosphere in respect to temperature, moisture, precipitation, sunshine,

wind, dust, and electricity. When the word is mentioned, we immediately think how hot or how cold it is, whether it is raining or the sun is shining, whether the wind is blowing, and so on. It requires only a moment's reflection to convince one of the great influence the weather must have upon the farmer and his work. Especially is this true of a large State with considerable variations in climate, such as Illinois.

Keep Weather Record

One of the most interesting and profitable things that can be done is to keep a weather record. This may be done by using a sheet ruled somewhat as follows:

DAY.	Temperature.			Precipitation.				Kind of Day.				
	Mean.	Highest.	Lowest.	Average.	Departure.	Snowfall.	Greatest in 24 hr.	Precipitation .01 inch or more.	Clear.	Partly cloudy.	Cloudy.	Prevailing wind direction.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
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24												
25												
26												
27												
28												

Sun Observation; Relation of the Position of the Sun to Seasonal Changes

From our geography, we all know how the earth revolves around the sun. The earth to us seems stationary, and the sun seems to move, but in reality, it is the other way. During six months of the year, the northern hemisphere is turned toward the sun, and during the other six months, the southern hemisphere is turned toward it. This is the cause of the change of our seasons. During the time when the northern hemisphere is turned toward the sun, the earth absorbs a great amount of heat from the sun during the long days, but during the time it is turned from the sun, it does not receive this excess heat. Hence, in the first period we have the heat of summer, and in the latter the cold of winter.

If we will notice the sun in summer, in the late afternoons we see that it shines in at north windows. In winter, it shines in at the south windows in the afternoon, but never in the north.

Clouds, Kinds

Every pupil is sufficiently familiar with a cloud to know what it is, but a more careful study of the subject is needed in this connection. The term cloud is used to denote the moisture of the atmosphere changed from an invisible state to minute particles that float for a long time in the air. Of course, these particles are so small that they cannot fall through the ordinary atmosphere on account of its resistance. The moisture of the air is condensed into particles of water by a reduction in temperature. Everyone knows that if air comes into contact with a cold solid, the latter will become covered with dew; and if two masses of warm-moist and cold-moist air come in contact, a slight cloud is formed. Also moist air may be cooled by radiation of heat and, when it gets to the dew point, a fog or cloud appears. However, the principal cause of the formation of clouds is yet to be mentioned—dynamic cooling. Air expands when it is brought under lower pressure and in expanding uses up its latent heat. Consequently in rising over a mountain or when raised by its own buoyancy, it expands and cools and clouds are formed.

NOTE.—*It is a very interesting work to keep a record of the days that are cloudy and partly cloudy during each month and compare the records.*

There are various kinds of clouds. Some of them are: cumulus, cerus, stratus, and the nimbus. Clouds are the result of the condensation of the moisture of the air. When the cloud comes low enough to touch the surface of the land, we speak of it as a fog.

The various names applied to clouds depend upon the formation, color, and shape of the cloud in question. Cumulus clouds are usually seen from about 10 A. M. to 3 P. M. in fair summer weather. The rising convection currents carry the air up where it expands and cools. When the dew point is reached, some of the vapor is condensed where it looks like great heaps of frothy suds or fleecy wool. The cumulus clouds are irregular while their tops constantly change in shape. The bases remain more regular and float 1000 to 2500 feet high.

Cirrus clouds usually precede a storm and are pale whitish plume like strips 5 to 10 miles high. They are formed by the currents of air that flow out of a storm area, and move steadily with the area of low pressure. They really because they are so high consist of ice crystals, if spread out in a sheet they are called cirrostratus.

Stratus clouds are seen near the horizon in the late afternoon or early morning. They occur in long bands called strata.

The nimbus is the dark rain bearing cloud. They often cover many thousand square miles. They are often but a few hundred feet overhead. They have no certain form, and often hang over a locality for days at a time.

Winds—Relate to Convection Currents; Effects of "Lows" and "Highs"

Winds are convection currents, and are caused by the force of gravity. They blow from regions of high barometic pressure to regions of low barometic pressure, while the greater difference between the pressure of the two areas the greater will be the velocity of the wind.

For purposes of study they are grouped into terrestrial, cyclonic, and continental winds. The terrestrial winds are due to the fact that our planet rotates and receives heat from the sun. When the air becomes heated at the *heat* equator it moves up this producing a low pressure belt at the equator and a corresponding high pressure belt near the tropics. The former is called the equatorial calms or the doldrums and is caused by the ascending air. The high pressure belt is known as the horse latitudes and is caused by the descending air.

The trade winds are those which blow from the region of tropical calms toward the equator. The anti-trade winds blow high above the regular trade winds and when they descend produce the tropical winds or horse latitudes.

The prevailing westerlies blow toward the poles from the horse latitudes.

Larre's General Science is a most valuable book for the study of this part of our agriculture. It is published by Silver, Burdette & Co., Chicago.

Weather Map

Throughout the United States and other countries, many observation stations have been located by the weather bureau. Each morning and evening at the same time a record is made of temperature, barometic pressure, direction, and velocity of wind, relative humidity, amount of rainfall, and appearance of sky. This information is telegraphed to the Head Bureau at Washington where from the combined reports, weather maps which show the weather conditions all over the United States are printed. Smaller maps are printed in the larger cities from information sent from Washington, and these are mailed to the section where the substations are located. From these the weather may be forecast for the next 24 hours, perhaps for a week or more.

The Weather Bureau and Its Work

The Weather Bureau of the United States was authorized by act of Congress in 1890. It provided that it should be established on and after July 1, 1891, and be attached to the Department of Agriculture. Section 3 makes clear the duties of the bureau:

"That the Chief of the Weather Bureau, under the direction of the Secretary of Agriculture, on and after July 1, 1891, shall have charge of the forecasting of the weather, the issue of storm warnings, the display of weather and flood signals for the benefit of agriculture, commerce, and navigation, the gauging and reporting of rivers, the maintenance and operation of seacoast telegraph lines, and the collection and transmission of marine intelligence for the benefit of commerce and navigation, the reporting of temperature and rainfall conditions for the cotton interests, the display of frost and cold-wave signals, the distribution of meteorological information in the interests of agriculture and commerce, and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties."

We too often think only of the bureau's work in forecasting the weather, but it also does another very important line of work in its climate and crop service. An accurate and comprehensive record of meteorological conditions are kept for this purpose.

Lighting and Light

Light is due to waves in the ether, a medium which fills all space, and is quite distinct from air. These light waves are produced by the vibrations of the same little electrons which produce

electricity. There is a close relationship between heat and light The former is due to the motion of molecules, while light is caused by the molecules causing the electrons to vibrate so rapidly the sensation of light is caused. In 1676 a Danish astronomer named Roemer measured the speed of light and found it to be 186,000 feet a second. Lighting is usually the term used to denote the use of artificial light.

3 Sources of Natural Light—Sun, Moon, Stars

Most of our light comes from the sun. The moon is a non-luminous body, and what light we receive from it, is light reflected from the sun. Most of the objects which we see are non-luminous bodies, and we see them merely because they reflect light from some other object. For this reason we can not see in a room where light is excluded. Some stars give light as does the sun; others reflect it as does the moon. Many of the stars we see are suns of other solar systems. All true stars twinkle, and have a light of their own, but the lights from the planets such as Saturn, Jupiter, etc., is merely reflected light like that from the moon. There are seven other planets revolving around the sun besides the earth. They are: Mercury, Venus, Mars, Saturn, Jupiter, Neptune, and Uranus.

4 Artificial Lightning. Different Methods.

In the days of our great grandfathers the methods of lighting the home were limited to the tallow-dip and the candle. As these were best known, and, in fact, the only ones known, people got along very well. But we have advanced a long way from those methods now, and they seem primitive indeed. With the advent of the various types of kerosene lamps, homes came to be very much better lighted. Then came the more modern methods of lighting by the use of gasoline, acetylene, and electricity. We do not mean to say, of course, that every farm home is now lighted by these last named agencies, but that many farmers are making use of them and probably in the near future many more will do so.

At the present time the use of candles has almost disappeared. They may, however, be seen occasionally because of their convenience in case of emergency. When other lights fail, for example, it is an easy matter to light a candle for a few minutes until they are repaired. Plumbers make use of the candle quite frequently in their work, especially when working in a dark corner. As to the expense of the candle, it is practically negligible.

Kerosene Lamps

According to reports, the first kerosene lamp was patented in 1859. Soon there were a score of applications and from twenty to eighty a year until about 1880. The simplest form of the kerosene lamp consists of the bowl, wick-holder, wick, and chimney. The bowl, of course, is the fount for the oil. The wick-holder is more commonly called the burner. It consists of a perforated platform device for raising and lowering the wick, and a dome surrounding the upper part of the wick. The perforations in the platform permit the passage of air to the flame, and the dome directs the currents of air against the flame.

Always keep the bowl well filled with oil and the wick properly trimmed. The wick should not be allowed to become too short. Certainly it should never be so short as to barely touch the oil. This kind of economy is not economy at all. If the flame discharges black soot which begins to accumulate on the chimney, this is a sign that there should be regulation of the air supply, the trimming of the wick, or similar needs.

There are several varieties of kerosene lamps. These we may enumerate as follows: the *flat-wick, lamp* the *round-wick lamp,* the *mantle lamp,* the *pressure lamp,* and the *angle lamp.* The best known is perhaps the flat-wick lamp, which generally has a wick an inch or an inch and one-half in width. It often furnishes light for sixty hours on a single gallon of good oil. The round-wick lamp is such that the wick is drawn into the shape of a cylinder, and the air may pass to the flame from both sides. The mantle lamp makes use of a mantle, suspended above the flame, by means of which a soft and pleasing white light is produced. The mantle is made somewhat as follows: A cotton netting is soaked in a nitrate of thoria and then burned, leaving only the framework of the net. This is next soaked in a solution of gun cotton in ether and castor oil. This gives firmness to the mantle. Of course, this material is burned off when the mantle is placed in position in the lamp. Keep the wick carefully trimmed at all times, but this does not mean that all the dark portions should be removed. It simply means that it should be smooth and even. The pressure lamp is one that does not make use of a wick, but supples the fuel by pressure. The angle lamp has the burner placed at an angle so that the wick is almost horizontal. It makes use of a double chambered bowl, the oil in the outer one being always kept at the same level.

Two Kinds of Gasoline Lamps

There are two kinds of gasoline lamps, those that furnish the fuel to the burner by gravity pressure, and those that fur-

nish it by air pressure. The former type of lamp has the bowl suspended above the burner. There is, of course, always danger in case of a leak, and for this reason the kind is being rapidly replaced by the air-pressure lamp. The air-pressure lamp raises the fuel to the burner under pressure applied to the gasoline. Often a hand pump is used to force several pounds of air pressure on the liquid. The air is pumped right into the bowl or tank.

A mantle is generally provided for the pressure lamp, and there is a device for volatilizing the gasoline so that it can be consumed as a gas. Some lamps of this kind may be obtained for as low a price as $10 or $12.

By means of the hollow-wire system gasoline can easily be used to light a whole residence, church, school, or store. The system consists of a pressure tank and a hand pump, hollow wire for conveying the gasoline, burners, and fixtures. The tank should generally be placed outside the building or, at least, where there is no danger of setting fire to the liquid. There should be a pressure gauge on the tank, and the tank should hold from five to ten gallons. In filling the tank, it is well not to put in too much gasoline. Some say that it should be filled three-fourths full of the liquid, this leaving room to force in enough air to provide the desired pressure.

As the use of gasoline is somewhat dangerous, the hollow wire and pipes should always be tested carefully and the tank kept free from fire.

Chandeliers of various kinds are used in the farm home. Often they consist of a single light and globe, but frequently two-light and three-light devices. A hanging chain enables the light to be drawn low.

Acetylene Lamp

Acetylene gas has been found to be one of the hydrocarbons, but much heavier than gas of the natural variety. When ignited it produces a somewhat smoky flame. When it is used in the proper type of lamp with a good burner, it gives off a very pretty light, almost white.

What are the advantages of acetylene? First, its odor is pungent, but not so offensive as gasoline. Second, it is said to use less oxygen from the air and so give up less carbon dioxide. Third, it does not explode in its natural state. Fourth, it is less poisonous than natural gas and other varieties.

Electric Lights

As compared with the other methods of lighting, electricity is far superior. There is no danger of an explosion, no offensive

odor, and little danger from fire. It is noiseless and practically without heat. The quality of the light is especially good. The tungsten burner, of course, should be used, as it is superior to the cheap carbon lamp.

The choice of fixtures must rest with personal taste. There ars so many varieties of fixtures and globes that one could hardly attempt an explanation. If the ceiling is clear and white, it is better to use a white globe so placed as to cast the light up to the ceiling, thus giving indirect light. This not only looks better, but produces a light that is not so trying on the eyes. If fixtures for direct lighting are used, care should be exercised in order to have the lights placed at the proper height.

Light Produced by a Flame; a Glow

In a general way, we have covered this point. Most of the kerosene lamps produce their light by a flame, and gas and acetylene also may be used in this way. When, however, the mantle is used, the flame is reduced to a bright glow. We have already discussed the mantle and its structure and have noted the fact that it makes a much more beautiful and pleasing light.

The electric light is produced by passing a current through a very fine coil of wire, producing an extremely bright glow. We have noted that the tungsten burner was better than the carbon burner. This is because the glow is much brighter and clearer. The carbon burner can be determined by the dark red color of its glow.

Candle, Parts That Produce Flame, Candle Power

The first candles were made by dipping a wick into some sort of melted fat, and then allowing it to cool. This process was repeated until the candle was of the length and thickness desired. They are now made of fats and various other kind of waxes that are moulded around a heavy string or wick. When it becomes solid it is ready for use. The flame is due to the combustion of the gases in the wax or fat. These contain particles of carbon which have been heated to a glow, hence the flame and light.

Light is measured by so many candle power. This candle power is the quantity of light given by a sperm candle of the sort known as "sixes," meaning six candles to the pound. Light is measured by an instrument known as a photometer.

If we wish to see how the flame is produced, take a new candle, one that has never been burnt. Light the wick at the end, and note how it burns up in a flash. A steady flame is not produced until the wax of the candle has become ignited.

Lights Used in Early Times; Pine Knot, Primitive Lamp; Candle; Kerosene Lamp, Experiments to Show use of Burner, Chimney, Etc.

The *pine knot* was the earliest means of lighting. It was burnt in the fireplace and the pitch and oils in the knot served to produce a flame that lit the room.

The *primitive lamp* consisted of a dish of fat or oil, with a rag held upright. This served as a wick and was ignited. It served as a make shift lamp.

Candles have already been discussed as has the kerosene lamp.

The burner on a lamp is used to mix the air with the carbon thus producing a steady light. If one wishes to see how the mixture of air affects a kerosene lamp, have him take a burner, rub soap or some similar material over the small holes in the bottom of the burner and try it on the lamp.

To show the part played by the chimney, remove the chimney from a lighted lamp.

To see how the wick serves its purpose, try burning a small quantity of oil or fat in an open dish.

Crude Petroleum and Its Products and Uses

Crude petroleum is a dark ill-smelling oily liquid obtained from oil wells in various parts of the world. Pennsylvania and Ohio had our first oil wells; Texas and California came next, while of late years especially rich ones have been brought in in Arkansas.

Its products are obtained by refining the crude oil and are:—petroleum, gasoline, ether, naptha, benzine, kerosene, paraffine, vaseline, and petroleum jelly.

Petroleum and gasoline are used as fuels or light. Ether is used in surgery as an anesthetic; naptha has various uses, mainly as a cleaning agent, benzine and kerosene are used as light or heat producers, paraffine in numerous ways, while vaseline and petroleum jelly are used in a medicinal way. But it is only fair to say that each product has other uses, far too numerous to mention here. The pupil is advised to study this subject farther.

Gasoline lamps have been discussed in a previous topic.

Gas may be divided into natural and artificial gas. The former flows from wells much like oil. It frequently is found in oil regions and to prospectors for oil, is a good indication that oil is present. Artificial gas in its manufactured states, makes use of crude oil, or petroleum, or some of its refined products.

ELECTRIC LIGHTS

How are the Lights Produced? How Electricity is Generated

Electric light is produced by the glowing of the wire filament used in the electric light bulb. The current passing through the filiament heats it to the glowing point, but the wire is not consumed for the bulb has had the air exhausted from it, hence there is no oxygen in it.

Electricity like heat and fire is produced by friction. If we rub silk with glass we get positive electricity, but if we rub hard rubber with a woolen cloth we get negative electricity.

A substance which conducts electricity we call a conductor and one which repells electricity we call a nonconductor. The best conductors are metals and solutions of salts and acids in water, while glass, rubber, dry air, wood, silk shellac, and oils are good insulators.

Every atom of all substances is known to contain both negative and positive electricity. The former exists in the form of electrons, or particles of negative electricity. The latter exists as the nucleus around which the electrons cluster. Now let us take a piece of woolen cloth and rub briskly a piece of hard rubber. The result is electricity is generated for some of the electrons are taken from the atoms on the piece of cloth and collected on the piece of rubber. Now we say the rubber has a negative charge for more negative particles have been deposited on it than there were and the total is greater than the positive particles.

But if a glass rod is rubbed with silk, the electrons leave the rod and cling to the silk. Then we say the glass rod has a positive charge since it has more positive than negative particles. This is the generation of electricity in its simplest form. In an unelectrified body the balance is maintained evenly between positive and negative particles.

Eyes and Lights

Most of our light comes from the sun, and hence is called natural light. Rightly used this is the nearest perfect light we can secure. The eye has been likened to a small camera, the pupil, which may be called the shutter, the crystaline lens or convex lens into the dark portion and the picture is made on the retina at the back of the eye. This corresponds to the plate of the camera. But it is far more delicate than any camera, and great care should be taken to protect it from injury or strain.

Parts of the Human Eye

The outer part of the eye are the *eyebrow, eyelashes, upper* and *lower lids.* The *eyeball* itself is set in a bony socket which is carefully padded with fatty tissue. It and the lids are covered with a mucus membrane called the *conjunctiva.* This secretes a fluid, which with the lachrymal fluid, secreted by the lachrymal gland, keeps the eye moist. The movements of the eye are controlled by six muscles.

In diameter the eyeball is about one inch. It is covered with a sclerotic coat except in front, and a point at the back where the optic nerve enters. This we call the white of the eye, and the part in front which is transparent is known as the cornea. The *choroid* is a second coat within the sclerotic. This contains a network of blood vessels and because of the dark pigment it contains is so black it looks like the inside of a grape skin. In front the choroid gives place to a sort of muscular curtain called the *iris.* It is the iris that gives the color to one's eye. The light enters the eye through the pupil or round opening in the iris. The third layer of the eye is know as the *retina.* It is a delicate layer of transparent membrane on which is spread the optic nerve. It is the only part of the eye sensitive to light The vitreous humor is a colorless jelly-like mass that fills the interior of the eyeball. The *crystalline lens* is between the vitreous humor and the iris. This focuses the light, and helps make the image clear and distinct. Between the lens and the cornea is a clear watery liquid known as the *aqueous humor.*

Care of the Eyes

One cannot be too careful in regard to the care of the eye. He should not read or otherwise use his eyes until they become overtired. A good way to rest the eyes is to lift them from one's work occasionally, and look off at some distant object for a few minutes. This rests the strained muscles, which keep the eye in focus. Nor should one work in dim light or in too glaring a light. Never work at close work with the sun shining on it. Beware of red lamp shades. Do not attempt to treat the eye for any ailment. If it needs treatment go to the best oculist obtainable. Never use glasses that were fitted to another person. If a foreign body gets in the eye, do not rub the injured member. Lift the lid gently and let the tears wash out the obstruction, or blow the nose gently. If it must be removed with a bit of cloth, be sure the cloth is clean. If the eye is inflamed a solution of boracic acid is a good wash.

Proper Methods of Lighting; Lighting in Homes and School Buildings

According to a report submitted by the Eye Sight Conservation Council of America, improper illumination has been a prolific source of poor eyesight.

The three important elements of lighting are declared to be:

(a) *amount of illumination,*
(b) *distribution of light,* and
(c) *diffusion of light.*

Since we are dependent upon the light from the sky for all our natural lighting and since it is far superior to any form of artificial light, every means should be provided whereby it can be utilized as much as possible. Windows and skylights are the most direct means of admitting light to a room. Therefore, in building a home or schoolhouse, provision should be made for them, and the architects design for the building should take this requirement into account.

The width of the class room should be governed by the number and location of windows. The room should be so planned that no seat or work space is more distant from the window than twice the height of the top of the window from the floor. This requirement was given by Guy A. Henry of New York, Director of the Eye-Sight Conservation Council. He has also given much careful attention to the size of class rooms and recommends one from 28 to 32 feet long, by 22 feet wide, with a ceiling 12 to 14 feet in height.

The diffusion of light is perhaps the most difficult problem that confronts experts, that is to secure the maximum light on the work, and yet at the same time to control the brightness of the light source. Diffusion is secured at windows by shades, and on lamps by shades or globes.

The light must come from the left side over one's work. Authorities therefore recommend unilateral lighting from that side. When this is not sufficient owing to the width of the room or various other causes, it is preferable to have additional windows on the rear rather than on the right side, unless the room is very wide. But if rooms like auditoriums are very large, windows on opposite sides are not objectionable. Overhead lighting from natural sources is not practical in many cases. When used, the light should come from a north skylight or saw-toothed roof construction, and be so located as to avoid direct sunlight.

But though daylight is the most perfect form of lighting, care must be taken with it as with artificial light, or harm may be done to one's eyes.

There have been many types of lighting fixtures placed on the market in the last few years. Many of them are wasteful of light as well as inartistic in design. For the home semi-indirect lighting by means of the translucent bowl is especially recommended.

The Oculist

The oculist is a physician who has given especial study to the eye, its treatment, and the fitting of glasses. A poor oculist is dear at any fee. In many small towns, some doctor who has failed as a general practicioner sets himself up as an oculist. The injury such men do to their patients is incalculable. When it comes to treating the eye, only the best aid obtainable is good enough. Better go without glasses than wear those fitted by someone who does not understand his business.

FOURTH QUARTER

POULTRY, BIRDS, LANDSCAPE GARDENING

Poultry—Different Kinds Found in Community

Turkeys, ducks, geese, and guinea fowls are the chief barnyard fowls besides chickens.

Turkeys are the only one of our barnyard fowls that are natives of America. They are undoubtedly descended from the American wild turkeys which were found wild over the greater part of North America. The wild turkey is easily tamed, especially if the eggs are hen hatched. There are six varieties recognized. They are the bronze, the Narragansett, buff, slate, white, and black.

They are the largest of our barn yard fowls, and because of their size, are profitably raised for their meat. The turkey is nervous in disposition, and does not do well if penned up. It is a rover by nature. The hen will lay from thirty to forty eggs in a season, but as the young are somewhat difficult to raise, many young are lost.

Ducks rank perhaps next to turkeys in importance Their eggs are little in demand except for hatching. There are at least ten different breeds and twelve varieties recognized. The adult will weigh from seven to ten pounds for the male, and six to eight for the female. They have some advantages over chickens, in that they are more free of diseases than chickens. They also require less care, if they have free access to a pond or stream.

Geese are raised for both their feathers and meat. There are at least six breeds and seven varieties which vary much in size, shape, and color. The males weigh twelve to twenty pounds when full grown. In size they rank second to turkeys. They are less extensively raised than ducks, since to do well they must have access to water at all times.

Guinea fowls are occasionally found on farms, but because of their semi-wild nature they cannot be classed as an economic bird. They refuse to make their nest except in hiding and if disturbed while sitting, will leave the nest and not return. There are at least four varieties of guinea fowls. They are natives of Africa. Since their flesh has a game taste, it is often sold and served as various kinds of wild fowl. Broilers pass as quail on toast, and the larger ones as pheasants, grouse, or prairie chickens.

They have a distinctive beautiful covering of feathers, and a harsh, discordant cry that is very different from all other barnyard fowls.

Study a Chicken

Unlike the other animals studied this year, the chicken is a biped, or an animal with two legs, and belongs to the avis, or bird family. Its general appearance is too well known to need discussion.

Feet and Wings

Beginning with the knee joint, the shank of the chicken extends to the toes or claws. This shank is sometimes partly covered with feathers and again is smooth, according to the breed. There are three toes extending forward, and one backward. As the fowls grow old, a spur develops at the side back above the back toe. Each toe ends in a prominent curved nail. The color of the shank depends on the breed.

The wing of a chicken is composed of three main parts. The part which joins the body is known as the wing bow, and is usually covered with fine, soft feathers. The second part is the wing coverts, forming the wing bar. The third part is mainly bone and skin, is short and bears the feathers known as the flight coverts. Just back of these feathers, and attached to the second part of the wing are the primaries, or flight feathers, while back of these attached to the main part of the wing are the secondaries or wing bay.

Sense Organs

The chicken, like most animals, has two eyes and two ears. The eyes are placed one on each side of the head, usually in a line with the beak. The ear lobes hang below and somewhat back of the line of the eye.

Food Procuring Organs

The chicken's food procuring organs are the beak and toes. The latter are provided with strong, curved nails, which not only can secure a good living for the fowl in question, but which will also work havoc in the garden should their owner leave the gate open.

FEATHERS

The greater part of the body of the chicken is covered with feathers. Usually the upper part of the head or comb, the bill, and feet are free of this covering. This depends largely on the

breed. Some breeds have feathers on the legs, others have none; some have but small, smooth feathers on the head, others have heavy neck feathers almost in a ruff form. The comb and wattles differ in the various breeds so much that they may be considered distinguishing marks of the breeds. This is true also of the feet and legs. In some breeds they are white, in others yellow or orange, in others black. The quality and color of the feathers are also distinguishing marks of breeds, and will be discussed as each breed is taken up in detail.

Parts of a Feather. Different Kinds Found on One Chicken

There are two parts to a feather, the *quill* and the *down*. The quill is the means whereby it is fastened to the skin of the foul and the down is the hairlike protrudences from the quill.

There are three kinds found on a chicken, the *down* from the breast and thighs, the wings and tail feathers, and the back and neck feathers. The most valuable are the breast and thigh feathers. The wings and tail feathers are rarely marketable, while the back and neck feathers may be stripped and sold as down.

Breeds of Chickens

There are one hundred four standard varieties of chickens raised in this country. However, the standard varieties may be divided into four general classes:

1. *General purpose* breeds, including the American class, the Orpingtons, and the Houdans.
2. *The meat or table* breeds, such as the Dorkings, Indian Games, and the Asiatic class.
3. *Egg breeds,* including the Mediterranean, the Dutch class, and the Redcaps.
4. *Ornamental* breeds, such as the Polish, Creve Coeurs, the Game, and the Game Bantam class, the Oriental Game, and various others.

In Class 1, we find the *Plymouth Rocks,* the most popular of all breeds of poultry, as a general purpose fowl. It is greyish white in color, each feather crossed by narrow, parallel bars of dark blue back. It is medium size, with broad, full breast, moderately large head, bright red, upright comb, yellow beak and shanks, and a large, bright red or bay eye.

They are hardy and mature early. They are good layers the year around. Their eggs are brown in color, averaging eight to the pound. They are good sitters and mothers. The standard weight ranges from nine and one-half pounds for cocks to six and one-half pounds for pullets.

The Wyandotte ranks next to the Plymouth Rock as a general purpose fowl. They average about one pound less in weight than the Plymouth Rocks, but are hardy and are prolific layers. Their flesh is sweet, juicy, and tender. There are eight varieties of the Wyandotte breed, the difference in color being the only distinguishing mark. The Silver Wyandotte has a silvery white plumage, with regularly marked black on the breast. The Golden Wyandotte is marked the same except it is golden bay instead of white. The other varieties, the Partridge, Silver-penciled, and others, are less known.

The Javas are one of the oldest of the American class. They enjoyed great popularity at one time because they were so prolific, but at present are having to give place to newer breeds. They are good mothers, good layers, and mature early. In size, they are about like the Plymouth Rocks.

Dominiques are similar in plumage. They have rose combs, and bright yellow legs. They are good layers, and mature early.

The Rhode Island Red is one of the newer breeds that enjoys great popularity. They are hardy, medium in size, lay brown-shelled eggs, are good sitters, and good mothers. The single comb and the rose comb are the two varieties of this breed. They average in weight from cocks at eight and one-half to pullets at five pounds. They are a rich, brilliant red in color, with black wings and tail. The hens are somewhat lighter in color than the cocks.

In the meat or table breeds among the Asiatics, we find the Light Brahma at the head. These have been known by various names, perhaps the most common being Gray Shanghais. In color, it is white and black, white predominating. A standard-bred bird should show no other color. The shanks are well feathered, with feathers extending down the middle toe. They are the largest of all domestic poultry and do well in confinement. They average twelve or thirteen dozen eggs per year. They lay well in winter. There eggs are large, averaging about seven to the pound. They are excellent in flavor and a rich brown color. They do not mature as early as some others, and as sitters and mothers are just fair. They are good for table use.

There are four varieties of *Cochins,* all popular with breeders. They are hardy and lay fairly well in winter. They are medium good fowls for table use and their eggs are of fair size.

The Buff variety is one of the most popular. They are a rich, golden buff color. They have heavy leg and toe feathering.

The Partridge Cochin, being more difficult to breed, is less known.

The Black Cochin is a rich, glossy black, while the White Cochin is pure white.

The Langshans are a popular breed of Asiatics. They are the smallest and most active of this class. Their flesh is of fine flavor, tender, and fine grained. They average twelve to thirteen dozen eggs per year. They are good sitters, good mothers, and the chicks are hardy and mature early. Because of their similarity in looks, the Black Langshans are sometimes confused with the Black Cochin. There are two varieties of Langshans—the Black and the White—the Black having glossy, metallic-looking feathers, with a greenish sheen. The White Langshans are pure white.

In Class III—the egg breeds in the Mediterranean—we find the *Leghorns* at the head. They are the best known of the egg-producing class. There seems to be no doubt that this breed originated in Italy. The Leghorns hold much the same place in the poultry house as a Jersey cow does in the barn. They are excellent foragers, light eaters, and mature early. The pullets often begin laying when four or five months old. They average one hundred fifty to two hundred eggs per year. The eggs are pure white, and average ten to the pound. For table use they are small. They are non-sitters. They must be warmly housed in winter if they lay well.

There are eight standard varieties of Leghorns: Single Comb Black, Silver Duck Wing, Single Comb and Rose Comb Buff, Single Comb and Rose Comb Brown, and Single Comb and Rose Comb White.

The Minorcas rank next to the Leghorns in laying qualities. They are very similar in looks to the Leghorns. Their origin is in doubt but some contend they came from Minorca Island in the Mediterranean Sea. They are one of our most profitable breeds of poultry. While they are good for table purposes, their chief value is as egg producers. They lay the year around but are non-sitters. Their eggs are white and average eight to the pound. They are hardy, mature early, and are good foragers. The comb of the Minorca is larger and bulkier than that of the Leghorns. The ear lobes are pure white. There are three varieties of Minorcas—Black, White, and the Rose Comb Black Minorca. In weight they average nine pounds for Single Comb Black cock to five and one-half for Single Comb White Minorca pullet.

The Dorkings come under the meat or table breeds and are of English origin. They are one of our oldest of domestic fowls. Its chief distinguishing mark is the fifth toe, which grows out behind, a little above the foot, below the spur. Its flesh is white and very delicate. They are not good layers but are good sitters and mothers. There are three varieties—the White, Silver Grey,

and Colored. The White is really the purest as to breed. Its color is pure white; comb, bright red, and shanks and toes white. The Silver Grey Dorkings are marked with black. The Colored Dorkings are black and straw color, while the female may show dark salmon on the breast. Dorkings differ in weight from nine pounds for colored cock to five pounds for white.

The Orpingtons are the latest importation from England. They are an all round, general purpose fowl of good size and good layers. Eggs are brown shelled. There are ten different varieties of this breed. The weight ranges from ten pounds in cocks to seven in pullets. The Buff Orpington is perhaps the most popular, and should be a rich, golden buff.

In the egg breeds in the Dutch class, the *Hamburgs* ranks first as egg producers. They are not sitters, light eaters, and good foragers. Their eggs are small and white shelled.

Since the ornamental class is bred very little in this region, it will not be discussed here. If interested, consult Farmers' Bulletin No. 51, Standard Varieties of Chickens, by George E. Howard.

Types of Chickens

There are four general classes of chickens. They are: (1) egg type, (2) meat type, (3) general utility, and (4) ornamental breeds, noted for style or as game breeds. The egg type is bred with the idea of securing the greatest egg production possible, while the meat type is intended for table use. The general utility type combines the best points of each, and ranks well either as an egg or meat type. The ornamental breeds are little raised in this country.

Feeding; Housing; and General Care of Chickens

Like all farm animals, chickens demand a balanced ration. But since heavy demands are made upon the hen in egg production, some elements are essential in her feed not required by other animals. Grit is one of these. It is useful not only in furnishing material for the egg shells, but in grinding up the food in the gizzard. Since most of the grits on the market contain little or no lime, this must be fed in the form of cracked oyster shells or mortar.

Meat is also an essential part of every poultry ration. This holds good for both grown and growing fowls, whether of the egg or meat type. From ten to fifteen per cent of the daily feed should be meat. It may be fed in the form of beef scraps, skim milk, or green bone.

There must also be a daily feeding of green stuff. Mangles may be used in the winter, and clover pasture in the summer.

Such food promotes health and aids in digestion. The grain ration should be one-half to two-thirds whole grain and one-third to one-half cracked or ground feed. Fowls may prefer the whole grain but in the laying season, food should be supplied that is readily used by the system.

Young chicks do not require feed for from twenty-four to forty-eight hours after hatching, since the yolk of the egg has been enclosed in its body, and supplies nourishment for this period. The first feed given young chicks may be stale bread dipped in milk. Ground corn soaked in milk is also good. Fine grit, charcoal ,and granulated bone should be fed along with the ground feed after the first few days. For the first few days, the young chicks should be fed five times a day. Then this may be reduced to four and later to three. They should be fed all they will clean up. Feed just enough to satisfy them. It is a good plan to feed over a light litter of straw, so they will have to scratch for it. Green food should be given twice a day. The night feeding should be heavy.

Fresh, clean water should be furnished the chicks at all times. It should be given in some sort of drinking fountain that will not allow the down of the chick to become wet. The flock should be sorted occasionally, and the stronger taken from the weaker. This prevents injury to the weaker ones and gives them a better chance at their feed.

The growing chick should have plenty of exercise. Free range should be given them. But they should never be permitted to run in moist, boggy land, but on a dry, southern slope.

Under normal conditions, the hen lays more in the spring than at any other season of the year. Hence, if we wish to feed for egg production, our aim should be to continue spring conditions as much as possible. If allowed free range, the hen in the spring will feed on fresh, tender grasses, bugs, and worms. This ration, or a similar one, combined with a slight grain ration, forms a good egg-production feed.

About one-half as much mash or ground feed should be fed as whole grain. Beets, cabbage, green clover, sprouted oats, fresh, green clover, or other succulent food should be fed unless the fowls have free range. Bone, charcoal, grit, and oyster shells should be accessible at all times. All food and scratch litter should be sweet and clean, free of all mold and mustiness. These are liable to cause serious digestible trouble.

The laying hen should be fed up to her capacity to eat. Dry food fed in a hopper is a most satisfactory way of feeding dry foods. Mineral matter may be given in the form of oyster shells, ground bone, or bone meal, or green cut bone.

In feeding for table use or meat production, an entirely different method must be followed. Some confine from twenty-five to fifty fowls in a small yard or pen, others use crates, holding four to six fowls each. Ten days to three weeks are usually required to put fowls in proper shape for the market. Before the fattening process is begun, they must be dusted with insect powder to free them of all vermin. The greatest care should be used that they are not overfed at the beginning of the fattening process. All the utensils around the pens must be kept sweet and clean. Beef scraps, skim milk, and grain are the best fattening foods. Some feeders prefer to have the grain fine ground and soaked in sour milk.

Broilers are the chicks marketed at six to twelve weeks of age. These vary from three-fourths to two pounds. The roosters fatten most profitably at three to four months of age, and should weigh at least six pounds.

Poultry houses should be clean, comfortable, and well ventilated. Most of the diseases of poultry are traceable to unsanitary housing conditions. The poultry house should be placed in a dry, well drained location, preferably on a southern slope, if this is possible. The poultry house should at least face the south, so that in the winter it can get all of the available sunlight. Four to five square feet of floor space should be allowed for each chicken. The colony house and the long house are the two general types of poultry houses. The colony house is intended to accommodate a small flock or colony and may be portable or non-portable. The portable house is usually placed in runners and drawn from one place to another. This type has many advantages over the non-portable, since after harvest, the houses may be taken to the fields and all the loose grain cleaned up. This also provides more free range, and a greater supply of bugs and worms.

The long house is less expensive to build and makes caring for the birds easier, but the chickens have less range, require more feed, and greater care must be used in keeping the yard clean. The scratching shed is one of the most valuable parts of the chicken lot. It is an ordinary shed, inclosed on three sides, and attached to the chicken house so the chickens can go in as they will. It provides both freedom and exercise for the fowls. It is advisable to have the windows low and wide and both glass and cloth provided in order to insure proper ventilation. One square foot of glass and one of curtain surface should be provided for each sixteen square feet of floor space. The floor may be of cement, dirt or sand. The latter are advisable, providing they can be kept dry and clean. If used they should be higher than the surrounding land.

Just what interior fixtures and labor saving devices are used depends much on the number of fowls, and the time possible to give to their care. If one begins the poultry business for profit, and on a large scale, the sooner one becomes acquainted with labor saving devices the better, but if the flock is small and kept only for home use, it will scarcely prove profitable to invest in much expensive equipment.

There is no animal, not even the dairy cow, that is more susceptible to housing conditions and general care than the hen. Many things may cause a hen to cease laying. Excessive heat or cold, fright, too little feed, and change of location are some of the most common causes of cessation of egg production.

Great care must be exercised in selecting eggs for hatching purposes. Eggs from strong fowls should be used. They should be uniform in size and true in color to that particular breed. Either natural or artificial incubation may be used. However, perfect as an incubator may be, it rarely equals the mother hen herself, provided she is wisely selected. Incubators of one hundred to two hundred egg capacity are hardly to be recommended, because of the fact that in a machine of this size moisture, temperature, and other vital factors are hard to control. A machine of six hundred to one thousand egg capacity is usually much more economical in the end.

If artificial incubation is used, artificial brooders must be provided. The first need of a young chick is heat. The temperature should vary from 90° to 100° F. for the first three or four weeks. It is always better to have too much rather than too little heat, provided the chicks may have an opportunity to get away from it, if they wish.

Selecting Hens for Laying Purposes; for Breeding

The egg type is neat and trim, very active, and upstanding. The body is spare and the legs long. A hen likely to make a good layer may usually be classed as small or medium. Its disposition will be nervous and active. They fly readily, are alert, and easily frightened. A good layer will mature early. Feathers, comb and wattles will develop early. Rapid feathering and rapid molting show great constitutional vigor. A good layer usually is a "non-sitter." They are excellent foragers, being active and industrious. The layer to do well must be given a good range. If she is, she will secure the greater part of her own living.

The molting period is a good time to select fowls for breeding purposes. A fowl that molts rapidly is of a strong, vigorous constitution. In making this selection, a fowl with a deep, long wedge-shaped body should be chosen, if the breeding is done

for egg production. Two year old hens are to be recommended, since they are more mature than pullets, hence they lay more perfectly developed eggs. One male should be selected for each fifteen to twenty-five hens. For best results choose only the eggs from the hens selected that are normal in size, perfect in shape, true in color, and of good, firm shell.

Incubators and Brooders

An incubator is really an artificial hen which depends on man to do its thinking. With good eggs, most makes of incubators will give good results, providing reasonable care is exercised in its management.

There are two types of incubators—hot water and hot air. The former is recommended when one thousand or more eggs are to be hatched at one time, but for the smaller numbers, hot air is perhaps to be preferred.

Top heat is essential. It must be uniform. The temperature of a brooding hen is about 104°. Fresh air is of prime importance and each machine must, therefore, possess sufficient ventilation. A certain degree of moisture is also essential, but the air must never be saturated.

No especial type of incubator can be recommended here. Each new one that appears on the market has some point of advantage over its predecessor. As a general rule, however, it may be stated that the machine which nearest follows the hen's method of hatching is most likely to be successful.

Printed directions are sent out with each incubator and these directions should be followed faithfully, since they are based on the experience of experts in handling that particular make.

The incubator should be placed where the temperature is more or less uniform. It should be airy but free of drafts. The place selected for the incubator often determines whether or not the hatching will be successful. Be sure it sets level. Always test it out for at least twenty-four hours before placing any eggs in it.

The eggs should be turned regularly twice a day from the third to the eighteenth day. After this, they need not be turned. The cooling of the eggs requires practice. At first it is done when they are turned. After the seventh day, once each day, the eggs are removed from the machine until they become cool. After the eighteenth day, they are not cooled.

After the eighteenth day, the incubator is closed and not opened until the hatch is completed. Twenty-four hours before the brooder is to be used, it should be heated to make sure it is dry and warm. The temperature should be at 95° when the newly hatched chicks are placed in it. They will raise the tem-

perature to 96° or even 98°. This should be maintained for the first week, then gradually lowered till it reaches 90° at the end of two weeks. From this on a temperature of 75° is sufficient in the hover.

There are many makes of brooders on the market, some of intricate design, others so simple they may be duplicated at little expense by the home workman. It is essential that the brooder be placed in a dry, light place, that an even temperature be maintained, and that there be plenty of space and good ventilation.

Value of Chickens

In economic importance there is no doubt that chickens rank first of all barn yard fowls. Turkeys are easily second, because of the size they attain—some of the Bronze males going over thirty pounds.

The census of 1900 showed that there were 233,598,085 chickens and guinea fowls on farms in the United States. The turkeys numbered 6,599,367; geese, 5,676,863, and ducks, 4,807,358. The same statistics showed that about 89 per cent of all the farms of the country kept poultry, and that the total value was $136,891,877. More than 250,000,000 chickens and other poultry are consumed every year for meat. This may be a surprise to many who do not realize that poultry for many centuries has supplied a large proportion of the food of man. Scarcely a country in the world but what recognizes that the poultry industry is an important part of the agriculture industry.

Under the term poultry, we can probably class only those fowls bred either for their flesh or eggs. For this reason, carrier pigeons cannot be called poultry, nor can pea fowls, bred for ornament, nor wild game come under this heading.

Chickens, geese, ducks, guinea fowls, and pigeons, used for eating purposes, are the chief kinds of poultry bred in this country. In some places, and especially in Europe, pheasants, quail, swans and pea fowl are bred for table purposes and therefore may be included.

Marketing Poultry and Eggs

One cannot discuss the subject of marketing poultry without a brief treatment of their preparation for the market. In this country there is usually no separate branch of the industry devoted to the fattening process. However, in Europe the rearing and fattening is done in entirely different places. In this country, the poultry raiser merely changes the diet and habit of the birds. Some advocate the small pen, others the crate method, while others contend that poultry allowed to run at large fatten more readily and cheaper than those confined. At present, ex-

periments seem to show that birds confined in small pens, and allowed some exercise, produce better flesh when brought to the markets. The poultry of the U. S. is marketed in two ways; either live or dead. Both have their disadvantages. If sold alive, one can be sure that the fowl purchased is fresh, but there is the added trouble of killing and dressing, which unless plenty of feed and fresh water is furnished the chickens, there is apt to be a serious loss from shrinkage with the attendant loss of flavor and flesh. The inhuman way in which much of the live poultry is handled has caused many states and cities to pass laws in regard to the care of them while displayed for sale.

If birds are killed before marketing, the utmost care should be taken to see that every possible rule of cleanliness is observed. Filth and dirt around any food is disgusting, but around meat it is positively dangerous, since it may lead to rapid decay of the flesh. All birds should be penned up and not fed for at least two hours before killing. This insures that the crop will be empty, as well as the intestines. The best way to kill the bird is to sever the main artery found in the roof of the mouth, then to hang the bird by the feet, head down, where it will quickly bleed to death. As soon as dead, the bird should be dry picked. Scalding may be resorted to if the bird is for home consumption, but is apt to give the skin a drawn, hard look. Care should be taken in removing the feathers that the skin is not torn. The animal heat should be driven out by cooling at once. Not to do so is to invite rapid decay. Some poultry men plump out the birds by putting them in cold water. This is not injurious if they remain but a few minutes, but any soaking until they swell beyond their normal size is not only injurious, but fraudulent. If housewives would refuse to buy fowls so treated the practice would soon be discontinued. The flesh of fowls so treated is apt to be whiter than that of fowls not so treated. The body will have a sleek, plump look, and the flesh will be hard to the touch. Decomposition of such flesh is more sudden and sooner than that of birds not washed. As soon as the animal heat leaves the body "rigor mortis" sets in. This stiffens the flesh and tendons until they become hard. The fowl should not be used now for at least twelve hours, or until this has passed away. Great care should be taken not to use flesh which has begun to decompose, for decomposition is often the herald of ptomaines, virulent poisons. Some people argue that birds keep better drawn than undrawn. The writer prefers drawn birds, for the fact that the intestines contain more or less moist digested material which rapidly gives off its odor and soon taints the whole fowl. Birds if drawn, and rinsed with clean salt water, will keep sweet two or three days longer than undrawn birds.

There is a widespread distrust of cold storage birds and eggs. This is founded on real facts and unless great care is taken in handling the cold storage products, they are unfit for human consumption. But if properly managed, cold storage fowl is not only healthful, but makes it possible for one to have the meat at less cost than one could obtain the fresh.

A temperature of 50° F. will keep poultry sweet a week or more, but if intended for longer storage a dry temperature of 34° F. or less is necessary. October till May are the usual cold storage months. Older fowls keep better in cold storage than do younger birds. Many of the delicate game birds do not keep well in any temperature. The main thing to know in buying cold storage products is how long they have been out of cold storage. Such products spoil much quicker than fresh ones, and if used at once are all right, but must not be used if they have been unpacked too long.

Different methods are employed in packing cold storage products. Sometimes the birds are frozen before packing. This is done at a temperature of 5° to 10° F. and then kept at about 30° F. However, most people hold that freezing destroys the fine flavor of poultry, and as frozen meats decompose very rapidly after thawing, ordinary cold storage is preferable. There are many things to note when selecting poultry. A good fresh bird will be well rounded, showing no bony angles around the breast bone. The legs should be short and plump. The skin should be clear yellow and free from blotches or dark spots. The flesh should give greatly when pressed by the finger. It should never be flabby or hard. A fresh bird will have soft, moist, limber feet and the eyes will be bright and full. If the bird is a cold storage one, its wings and legs will probably be close to the body because it has been packed in tightly with others. If fresh, its wings will hang in a natural position. The breast bone of a young fowl is easily bent. The feet of a young fowl are soft and smooth, but hard and rough in an old fowl. A young bird has short, sharp claws, but an old bird has long, blunt ones. Turkeys up to twelve months have black feet. Up to three years old they are pink; after this they turn a dull grey. Red feet are a sign of age in a pigeon. The flesh of the breast of a pigeon will show dark through the skin if the bird is an old one.

In ducks and geese, the wind pipe furnishes the best test of age. In a young bird it is soft and flexible. In an old one it is hard and fixed. Sometimes the wings of turkeys, geese and ducks are left unplucked. When so left, they give a clue to the age of the bird. If the quills at the tip are sharply pointed the bird is young, but if blunt it is probably old. The American

farmer is slowly but surely learning the folly of keeping an oversupply of cocks, and as they bring a lower price when put on the market for food, the up-to-date poultry raiser usually caponizes them. The meat of capons is unexcelled for table use in flavor. Capons also take on flesh more rapidly and with less food than regular fowls. The meat is juicy and tender, and the body several pounds above normal chickens. The demand for capons is an increasing one in the American markets, and the wise poultryman is meeting the demand more fully each year.

The marketing of eggs is not as complicated a matter as that of marketing poultry, yet the day has passed when the thrifty farmer will start to town with a market basket filled with eggs, and trust to luck, and the good roads movement that thew will all arrive safely. Many farmers now sell their eggs to hucksters who make weekly trips through the country buying the farmers' produce. They are usually packed in crates holding twelve or more dozen. For retail trade in the city, paper cartons holding twelve eggs are used. Parcel post has opened up an avenue of marketing for many farmers, yet this has not been the success it was hoped it would be, owing to the care with which the eggs must be packed and the expense of sending back their empty containers.

NOTE—*Most farm boys and girls have or have had some experience in keeping poultry of some kind or other. Lead them to discuss their experiences. Explain any difficulties they may have met and suggest possible improvement. Some poultry journal should be kept on the school library table for reference. Have them discuss the various breeds, advantages and defects. Make the subject of real practical benefit to the students.*

Prices of Broilers; Fries; Hens; Eggs

Broilers are chickens weighing around two pounds each, even less. They bring a high price in May or even June. Squab broilers are those weighing about ¾ pound each. These bring $1.00 to $1.50 per pair.

A spring or fry is a young soft-boned bird of either sex that weighs over two pounds. A hen is a female over one year old. It is difficult to give any scale of prices that will mean much. The season of the year, supply and demand, condition of fowl, and many other factors enter into the determining of the price. Fries vary from 30 to 80 cents, hens 25 to 45, while eggs vary according to the size, color, and season from 20 to 90 cents per dozen.

Last year in New York City in December, 1924, eggs were quoted as follows: Fancy Whites, 76 to 82 cents; Browns, 57 to 63 cents; Fresh extras, 54 to 55 cents; Firsts, 48 to 50 cents;

Seconds, 42 to 46 cents; Refrigerator Extras, 38 to 39 cents; Refrigerator Firsts, 35 to 36 cents; No. 1 Dirties, 23 to 24 cents; Checks (cracked) 22 to 24 cents.

In 1917 the average price on eggs was about 30 cents, and for dressed poultry 26.

Other Poultry

Turkeys, ducks, and geese are the other poultry usually raised on the Illinois farm. In 1910, Illinois ranked third in the United States in the value of her poultry, having $11,697,000. Iowa was at the head with $12,270,000, and Missouri second with $11,871,000.

Comparative Study of Chicken, Duck, Goose, Turkey; Care of

In shape, a duck is more like a goose having short legs and web feet, a long body and short tail, with very long neck and large heavy bill. Like geese, ducks are lovers of the water, but neither require swimming places, if plenty of clean fresh water is supplied, deep enough for the goose or duck to get its head in above the eyes. For some peculiar reason this seems essential. Both are very unlike the turkey in appearance or habits.

The Pekin, Muscovy, and Indian Runner are the best breed suited to the farm purposes among the ducks. Among the various breeds of geese, the Gray Toulouse and White Emden are the standard breeds for general purposes. While both ducks and geese like water, their houses must be free from dampness and have good drainage. Like a chicken's comb, their feet seem to suffer from the cold damp quarters. Ducks are more difficult to raise than geese, and require much more knowledge and care. They require much feed and water and regular hours of attention. They seem to form habits that they find hard to give up. For instance, if they are not fed corn while young, many never learn to eat it, and few seem to like it. But if they are fed it while small, they find it their favorite feed. Unlike the hen the duck has no crop, and the food passes at once to the gizzard, hence it should in the main be of soft foods. Wheat bran, corn meal, beef scraps, alfalfa or other green food, with coarse sand or grit, should be mixed with water till moist but not wet and fed three times a day.

A supply of oyster shells should be convenient, as well as plenty of clean water.

Geese are much easier raised than ducks, in fact, it is a common saying that a gosling a week old is a grown bird as far as any care it may require is concerned. If left to itself with plenty of water and good forage, it will shift for itself.

Their manure is very valuable, and should be collected from their houses at regular intervals. Their houses need be but little more than sheds, with litter on the floor. Geese are profitable in that they graze on land otherwise unproductive. They require drinking water in abundance and unless they have a pond for swimming, should be watered from shallow fountains in which they can get but their bill. If larger, the water soon becomes exceedingly foul.

Geese, unlike ducks and chickens, attain great ages, some living as long as 40 years, while frequently they live 15. They seem to retain their laying and hatching powers as long as they live.

When selecting breeders beware of immature stock. Ganders three years of age are best. When pastures are short and geese must be fed, corn meal, bran, middlings, and scrap meat is recommended. Cooked vegetables, steamed clover, or vegetable parings should constitute at least 10% of the whole. Like chickens, geese require grit and oyster shells.

Like chickens, turkeys require much more care than geese or ducks, especially the young. The Bronze is the most popular breed today, then comes the Narragansett. The general appearance of the turkey is to well known to need description. But the male it may be noted differs more from the female than do ducks or geese. They are also a larger bird, goblers going to 36 lbs. for standard to 50 pounds or over. Among white turkeys 18 lbs is the standard size for hens and for cocks 28.

After young turkeys are six weeks old they require little care or attention. Beware of inbreeding if you wish healthy young turkeys. New blood is vital in raising the young. The tom should be a year old and the hens two. With geese one gander to each three females is required, but one goblers to three or six hens is sufficient. Turkeys require much food and plenty of exercise. Do not keep them too fat. They do best when they roost in the open. Watch for vermin on the young and be sure their food is not sour or mouldy. Don't overfeed or over crowd.

Note Resemblance and Difference. Ducks and geese are more alike in body shape than chickens and turkeys. Their habits are also similar. However, ducks require more care than geese, and turkeys, more care than any of the fowls. This applies mainly to the young.

Like chickens, turkeys, suffer more from vermin than do ducks or geese. They are also more affected by damp weather. They require a better quality of feed than chickens do also. The poults are seed eaters, not slop eaters. Bugs, worms, seeds and such are their natural food and less apt to cause bowel

trouble than is the feeding of concentrated wet foods. Some breeders stay with a grain diet. Corn meal and skim milk curds are both bad for young fowls. Milk fed judiciously is all right. Stale bread soaked in milk, then pressed dry is good for the first few days. This should be sprinkled with fine grit. A small amount of hard boiled egg is good. Fine oatmeal or finely cracked oats and corn and granulated beef scraps are excellent. Meat must be sweet, for tainted meat starts bowel trouble in young turkeys. Green stuffs should be at least one-half of the fare. Provide plenty of water and add finely ground charcoal to the food.

Turkey hens do not as a rule care for their young as well as chicken hens, and the young turks seem much slower to learn how to eat than do either chickens or ducks.

Value

Like chickens, the value of ducks, geese or turkeys depend or various factors including supply and demand and seasons of the year. Ducks, turkeys and geese perhaps bring the best price during the late fall and winter, the demand falling off with the approach of spring. Turkeys bring the best price—the price in city markets last year at Christmas time being 50 to 60 cents per pound.

Geese bring from 14 to 30 cents per pound. Ducks slightly higher in price, depend upon whether they are milk, flesh, or grain fed.

Season of Marketing

There is the greatest demand for ducks, turkeys, and geese around the holidays. The demand for chicken is more constant throughout the year.

Value of Feathers

Too often the value of the feathers is ignored by the poultry raiser. Exclusive of ornamental feathers the United States imports over $2,000,000 worth yearly. Geese feathers are the most valuable and bring about one dollar a pound. Since geese may be plucked two or three times a year, one can easily see how they may be a source of income. Dry picked feathers sell for more than those of scalded fouls, and white for more than colored. Duck feathers rank next to goose, though carefully selected white turkey feathers will bring as good a price. The body feathers from white chickens come next to duck feathers.

The down from geese often sells as high as $1.50 per pound, and is used in making quilts, cushions, etc. Tail and

wing feathers are used for dusters and screens, feather boas are made from hackle feathers. Some are used in the manufacture of imitation birds. Peacock feathers are in demand for ornamental purposes.

White chicken feathers are worth about 18 cents per pound. Colored about 6 cents per pound.

BIRDS

Identification of Common Birds

The study of birds and their habits is one of the most fasinating bits of work the average boy or girl can undertake. The country child has a great advantage over the average city child in this work, but since parks are becoming more numerous, the city child has also an excellent opportunity to become acquainted with the feathered friends of the woods. Two things are necessary in studying birds—unlimited patience and some help—either that of a bird lover or a good bird guide. A field glass is also of great aid but the average keen eyed youngster will not find this absolutely necessary.

Many arbitrary divisions have been made in classifying birds. They are often divided into the following main groups: (1) diving birds; (2) swimmers; (3) wading birds such as herons and storks; (4) shore birds such as snipes and sandpipers; (5) the Gallinaceous birds such as grouse, partridge, and bob-whites; (6) Columbae, including pigeons and doves; (7) birds of prey such as hawks, owls, and vultures; (8) wood peckers; (9) goatsuckers, and (10) perching birds. They are also other minor divisions which are little known in the region of Illinois. The first four divisions will not be treated here because they are not familiar to this locality.

The Bob-White is a Gallinaceous bird, and one of the most celebrated game birds in the U. S., where it is found from N. Dakota east and from Texas north to the British provinces. It's nest is made in sheltered spots along the road side of dried grasses. Ten to twenty pure white eggs are laid each season, but rainy weather often destroys many of the young. They are familiar to most farm boys and girls by their short legs and necks, brown compact bodies and white throats. All the birds mentioned in this work may not be found in this state, but are given because native to the region east of the Mississippi, south of Canada, and west of the Gulf states, although they may also be found in other regions.

Among the birds of prey found in this region are the (1) Turkey vulture (2) Marsh Hawk; (3) Cooper's Hawk; (4)

Red Tailed Hawk; (5) Rough Legged Hawk; (6) Bald Eagle; (7) Barn Owl; (8) Great Gray Owl, and (9) the Screech Owl.

The Turkey Vulture is about thirty inches long, blackish brown, naked red head. In flight the tips of its wings curve upward. Two eggs are laid for one sitting in hollow stumps, under logs, between rocks, etc. The eggs are creamy or bluish white spotted with brown and faint markings of lavender.

The Marsh Hawk is very abundant in many sections. For two years the bird is reddish brown, after this it becomes very light colored. Both plumages show a white patch on the rump. Field mice form a large part of their diet. Their nests are made in swamp ground. It is usually well lined with grasses and rushes. They lay from four to seven pale bluish white eggs.

The Red Tailed Hawk is best known in the east, where it is called "Hen Hawk." It is one of the handsomest of the larger hawks, and the adult is easily distinguished because of its reddish brown tail. Snakes, mice and lizards are its main diet and very occasionally young chickens. The nest is made in tall trees of sticks, weeds and trash. The eggs are two to four in number, white and sometimes spotted with various shades of brown.

The Rough Legged Hawks are heavy, large birds of prey, with completely feathered legs. It is about 22 inches long and has a whiteish head, neck, breast and tail. The remainder is a blackish brown. The nests are usually built in trees. They lay three eggs, bluish white in color, splashed with dark brown.

The Bald Eagle is found sparingly throughout all of North America. It is most abundant along the Atlantic coast. It has a white head and a white tail after it becomes three years old. Before this time they are blackish. It is about thirty-four inches in length and has a wing expansion of seven feet or more. Birds two years old are larger than the adults. Fish is their main food, which they often steal from the Osprey, carrion and ducks, which they catch on the wing. Their nests are massive structures of sticks, usually in tall trees. They usually lay two white eggs.

The Barn Owl is very common in the southern states. It is one of the lightest colored of the owls and has a long peculiarly hooded face, from which it is often called monkey faced Owl. Its plumage is yellowish buff, slightly barred with black. It will nest in almost any concealed place, hollow trees, barns, or holes in barrels. It lays from four to six pure white eggs.

The Great Gray Owl is the largest of American Owls, being about twenty-six inches in height. Its plumage is very light and fluffy, dark grey in color, mottled with white. The face is

large, the eyes small and yellow. Their nests are usually built in pine trees of sticks. They lay from two to four white eggs in May or June.

The Screech Owl has two color phases, being a yellowish brown or grey, and black and white. They nest in hollow trees, especially in decayed apple trees. They are also found in abandoned barns. Mice, meadow moles and small birds are their chief diet. Their eggs are five to eight in number and are white.

Among the Woodpecker family we find the (1) Hairy Woodpecker, (2) Yellow Billed Sapsucker, and (3) the Red-headed Woodpecker.

The Hairy Woodpecker is found from North Carolina to Canada and east from the plains. They lay their eggs in holes in tree trunks or limbs. They usually use the same hole year after year. The eggs are glossy white, from three to six in number. They are nine inches long and have white outer tail feathers which are unspotted. They are similar to the Downy Woodpecker, which has the outer white tail feathers, spotted with black. The Hairy Woodpecker is much more shy than the Downy Woodpecker which often associates with other birds.

The Yellowbellied Sapsucker is one of the most handsomely marked of the woodpecker family. They are easily recognized by the red crown and throat (white on the female) bordered with black, with yellowish underparts. These are slightly injurious to cultivated trees, but are the only species of the woodpecker family that are. The eggs are four to seven, glossy white, and laid in holes in trees usually far above the ground.

The Red-headed Woodpecker is a beautiful species with a bright red head, neck, and breast, glossy blue-black back, wings and tail, and white underparts, rump and secondaries. It makes its nest in trees, telegraph poles, or under the eaves of buildings. They are rather quarrelsome among themselves, and with other birds. They sometimes tear down the nests of other birds and destroy the young. They feed upon ants, larvae, fruits and berries. They lay four to eight white eggs in May and June.

The Northern Flicker is a variety of large woodpecker, sometimes known as a Yellowhammer. They have a brownish tone to the plumage, barred on the backs, and spotted on the breast with black. Some have a golden yellow lining to wings and tail. It has a red crescent on the nape and the male has black moustache marks. They have the undulating flight common to all woodpeckers and show the white rump patch conspicuously when flying. They lay five to ten very glossy eggs anywhere they can make a hole for them.

Goatsuckers are long winged birds, with small bills, but very large mouths. Their plumage is mottled black, brown and white. Their food is mainly insects which they catch upon the wing.

The Whip-poor-will, a Goatsucker, is a species well known by sound, but scarcely at all by sight. It rarely leaves its place of hiding before dark. It is much like the night hawk from which it may be distinguished by the absence in the wings of any white markings, and by the white tip of the outer tail feathers of the Whip-poor-will. They fly very quietly through the air after nightfall. Their two eggs are laid on the ground among dead leaves usually in dense woods. They are grayish, white. or cream color, marbled with pale brown and grey and with faint markings of lilac.

The Night Hawk is a species of the Goatsucker, much like the Whip-poor-will. It does not have the mouth bristles as the latter bird does, but it has a forked tail with a white band near the end, and with a white band across the primaries, the latter mark showing very plainly during flight. They are very common in the cities as well as in the country, where they lay their eggs upon gravel roofs. The eggs are grayish in color, marbled, blotched and spotted with darker shades of grey.

The Humming Bird belongs to the same general family as the goatsuckers. The ruby throated humming bird is the only humming bird found east of the Mississippi. It is between three and four inches long, with green upper parts, and a bright red throat. It makes a beautiful nest of plant fibers and down. This is covered with green moss, and attached to a limb of a tree usually well out of reach from the ground. It lays two white eggs in May or June.

The birds most common and most numerous in this locality belong to the Perching Birds, or the order of passers.

Of the Perching Birds, the *Phoebe* or *Bridge Bird* is one of our most useful. It is so called from its habits of building in or around bridges. The nests are made of moss, mud and grass, and lined with feathers. They are greyish in color and very useful in that they feed on insects and beetles almost entirely. Four or five eggs are laid each year.

The Pee-wee is one of the best known birds in open woods, where it call of pee-a-wee or pee-wee may be heard. Their nests are built on the limbs of trees of fine grasses and covered on the exterior with lichens. They are very shallow and resemble a knot on the limb. They lay three or four cream colored eggs, spotted at the large end, in a wreath reddish brown and lavender.

The Prairie Horned Lark has a pale yellow throat with a line of white over the eye and forehead. In the Mississippi valley they are the most common of the nesting birds, and build on the ground in meadows and cultivated fields. The nests are made of grasses lined with feathers or horse hairs. They raise two or three broods each season. They lay three or four olive buff eggs, thickly sprinkled with drab and lavender.

The Blue Jay is one of the prettiest of the Jay birds and is too well known to need description. It is a cruel, quarrelsome bird. In fall, winter, and spring they feed on chestnuts, berries, seeds, insects, grains, lizards, etc., but during the summer they feed on the eggs and young of other birds. They usually build near the ground, almost anywhere, the nests being made of twigs and fine rootlets. In May, they lay four to six eggs of a greenish buff color, spotted with olive brown.

The Crow is very shy and cunning, and is the sworn enemy of every farmer. They build their nests preferably in the tops of tall pines. The nests are made of sticks and lined with rootlets. The eggs from four to seven in number range from a bluish white in color to a light green, and are spotted with shades of brown and lilac.

The Bobolink is well known in the East where his sweet call often given on the wing is much loved. During May and June, he sings all day long to his sparrow-like mate, sitting on her eggs concealed in the meadow grass. They are sociable birds and often several pair will nest in the same meadow. The nests are built in a hollow of the ground, lined with grass, and the top slightly arched to conceal the eggs, which are a greyish white, spotted with grey, brown and lilac. They are four or six in number and are laid in June.

The Red Winged Blackbird is a very familiar bird around grain fields in the fall where they often do much damage. They also do much good at other seasons because of the weed seed and insects they destroy. Their nests are made of grasses placed in bushes in swamps or over water, or again on the ground in clumps of grasses. The eggs number three to five, are bluish white and boldly spotted with dark brown and purple. The body of the bird is black with red wings with white markings.

The Meadow Lark is more frequently heard than seen. His note is a high pleasing flute-like whistle, with variations. It has a yellow breast with a black crescent. Their nests are skillfully concealed on the ground among the tall grasses of the meadow. In May or June they lay four to six eggs, white, speckled with reddish brown and purplish.

The Baltimore Oriole is easily distinguished by its orange flame color, and its black head. Elms are the favorite places for their nests, which hang like tiny swinging baskets. They are often five inches wide by ten long, and are built of fiber and bits of string. The eggs are white, streaked with black, brown or grey.

The Purple Finch is a very sweet songster. They breed in orchard trees, or evergreens, usually about three-fourths the way up. The nests are made of fine weeds and grasses and lined with horse hair. The eggs, usually laid in June, are greenish blue, spotted with dark brown.

The Goldfinch is one of our sweetest songsters from May until September. They are the latest of our nesting birds, building in late August or September. The nests are built in bushes, generally within fifteen feet of the ground, of fiber plants and thistle down, firmly woven together. They lay from three to six plain bluish white eggs. They are yellow in color, with dark wings spotted with white. The tail is dark as is also the top of the head. There are at least twenty-five varieties of the *sparrow family* in the United States. Because the *English sparrow* has proved such a nuisance, we have come to condemn all the rest of the sparrow tribe. The English sparrow was imported from England, and increases in such alarming numbers that a bounty was finally put on its head. They build unsightly nests of loose straw anywhere, and lay four to eight eggs in a set, with four to eight sets a season. Their eggs are whitish, spotted with grey and black.

The Vesper Sparrow is a streaked greenish buffy and white bird distinguished by its chestnut shoulders and white tail feathers. Their loud piping whistle may often be heard in weedy pastures in the East . They build in the hollow of the ground, lined with grasses. The eggs, four to five in number, are dull white, blotched with light brown and lavender tints.

The Lark Sparrow is a handsome bird with the sides of the throat and a spot on the breast black, while the sides of the crown and ear particles are chestnut. They are very sweet singers and always welcome. They usually build in the ground, but sometimes in bushes or even in trees. The nests are made of grasses and weeds, and the eggs, which are usually laid in May are white, marked at the large end with black lines and spots.

The Chipping Sparrow is sociable not only with other birds, but also with man, unless a locality is overrun with English sparrows. You will find these tame birds in vines, bushes and trees. They are a reddish brown bordered by black, with a black line running through the eye. Their nests may be found

almost anywhere and are made of fine grasses and weed stems, lined with hair. They lay three to five eggs of a bluish green, slightly speckled at the large end with brown and lavender.

The Field Sparrow is found abundantly along road sides in thickets and barren hillsides. They build their nests of stems of weeds and grasses, either in trees, bushes, or on the ground. They are the bird whose high piping notes are most often heard in the hot, sultry summer days. Their eggs are pale bluish white, speckled with yellowish brown, and greyish purple.

The Song Sparrow is abundant, especially in eastern localities, where he is a great favorite. They are sweet and persistent singers along roadsides, pastures, gardens and door yards, if there are no English sparrows near. They build either on the ground, or in bushes. The nests are made of grass and weed stems, lined with fine grasses or horse hair. They lay two or three sets of eggs each season, three to five at each set. They are white or greenish white, and sometimes are very heavily blotched with many shades of brown. Others are almost clear.

The Swamp Sparrow is a common dark colored bird which frequents swampy places, where it breeds. Because of its shy habits it is often unknown in the localities where it really is abundant. Its nest is usually built on the ground in places where walking is uncertain and treacherous. The eggs are much like those of the Song Sparrow, but are usually darker, more clouded and smaller.

The Cardinal is one of our most beautiful birds. It is firey red and crested, and are found around dwellings as frequently as in wooded localities. Their nests are nearly always within ten feet of the ground, built in bushes, branches, vines, or brush heaps, of twigs, coarse grasses, weeds, bits of bark, or leaves, and lined with fine grass or hair. They often lay two or three sets of eggs each season, with three to five white or pale bluish white eggs in each set.

The Rose Breasted Grosbeak is a beautiful black and white bird with a rosy red breast and under wing coverts. It is one of the most pleasing of our songsters. They nest in bushes and trees, usually six to twenty feet from the ground, and seem to prefer scrubby apple trees. They lay three to four eggs, greenish blue in color, spotted at the larger end with reddish brown.

The Indigo Bunting is a rich indigo on the head and neck, shading off into a blue or bluish green on the upper and under parts. In some localities they are very abundant in thickets, along roadsides, and open woods where their sweet song is heard. It resembles somewhat the song of the Goldfinch. Their nests are built at low elevations in thickets and vines and in very substantial structures, of leaves, grasses and weeds, being lined with

fine grasses or hair. The eggs are a pale bluish white and are laid in June or July.

The Blue Grosbeak is smaller than the Rose Breasted Grosbeak and is a deep blue with the wings and tail blackish, and the lesser coverts and tips of the greater coverts, chestnut. It nests in low bushes or vines, and is fairly common in its range. The nest is made of rootlets and weed stalks, grasses, and sometimes leaves. The three or four eggs are bluish white and unmarked.

The Dickcissel is a sparrow like bunting with a yellow breast patch, yellow line over eye and on side of throat. The throat is black, chin white, and wing coverts chestnut. They are very common in bushy pastures and on the prairies. Their song is simple and persistent, and usually very welcome as it is most often heard on very hot days when other birds are quiet. Their nests are built almost anywhere that suits their fancy, on the ground, in clumps of grass, in bushes, clover pastures, thistles or low trees. The nests are built of weeds, grasses, leaves, and rootlets lined with fine grasses. The bluish white eggs are three to five in number.

The Scarlet Tanager is a beautiful scarlet and black bird. The body is red while the wings and tail are black. They breed in orchards, woodlands, or small pine groves. They are quiet birds, but their low warbling song is heard at a great distance and is readily recognized because of its peculiarity. They nest upon horizontal limbs or poles, usually four to twenty feet above ground. Their nests are frail structures of twigs, weeds, and rootlets. The eggs are greenish blue, spotted with various shades of brown.

The Purple Martin is a large lustrious steely-blue swallow, which readily adapts itself to its surroundings. Throughout the East beautiful bird houses provided by land owners are found, often modeled after modern residences, and housing twenty to thirty pairs of martins. Soap boxes seem to provide as choice nesting places and in them they make their nests of weeds, grasses, mud and feathers. In June and July they lay four to six white eggs.

The Cliff Swallow may be easily recognized by its brownish throat and breast, whitish forehead and buff rump. They build very peculiar nests, often flask shaped. It is made of mud and fastened to the face of a cliff or under the eaves of a building. The entrance to the nest is small, but the nest itself is rounded. The eggs are creamy white, spotted with brown.

The Barn Swallow is the most beautiful and graceful of the swallow family. It flys in long, graceful sweeps, curves and turns, its lengthened outer tail feathers streaming behind. They

nest in sheds, barns, or wherever they will not be disturbed. Their nests are made of mud and attached to rafters. The outside of the nest is rough, but the inside is warmly lined with feathers. Their eggs cannot be distinguished from those of the Cliff Swallow.

The Tree Swallow or White Bellied Swallow is vivacious and active. It nests around houses, either in the city or the country. If English sparrows are kept away, they will nest in homes provided by man. Their nests are made of straws and grasses, lined with feathers. The eggs are four to six in number, and plain white.

The Cedar Wax Wing is a very gregarious bird and usually goes with others in large flocks. During the breeding season these split up into smaller groups and nest in groves, orchards, or in almost any kind of tree. The nests are often quite bulky, being made of string, grasses, strips of bark, mosses, etc. The eggs are dull greyish blue in color, speckled with blackish brown. They are often known as Cherry Birds because of their great fondness for cherries, both wild and cultivated. They are also fond of berries and insects, which they catch upon the wing. Their only notes are a strange lisping sound, often barely audible.

The Shrikes belong to the Laniidae family. The *Loggerhead Shrike* is greyish above and white below. It is about nine inches in length. It has black wings, tail, and ear patches sharply defined. It has white outer tail feathers and primaries. It nests in hedges or heavy brush, preferably thorn bushes. Their nests are mere piles of rubbish. In May, they lay four or five eggs. They are bold and cruel birds and feed upon insects, rodents and small birds, in the chase of which they show great skill.

The Red Eyed Vireo is a most persistent songster and frequents groves, open woods, or roadsides. Their eyes are brown, scarcely more red than those of any other species. Their nests are swung from the forks of trees, usually within ten feet of the ground. Their nests are so well built they often hang for several seasons. Their three or four eggs are usually laid in May or June and are white, slightly speckled with a blackish brown. The Cowbird often lays its eggs in the Vireo's nest.

The Warbling Vireo is not as well known as the former, but is quite as abundant. Their nests are smaller and placed higher above ground. Their song is more musical and sweeter than the former.

The Yellow Throated Vireo is wholly unlike any others of the Vieros. It has a bright yellow throat and breast, the upper parts are greenish, while the wings and tail are grey. The latter has two white bars. The eggs are four or five in number, pinkish

or creamy white, and speckled at the larger end with reddish brown. The nests are basket shaped affairs, often beautifully made and covered with lichens.

The White Eyed Vireo has white eyes, is yellowish green on the sides and with two prominent bars across the wings. They have no particular song, but a strange medley of notes resembling those of the Shrike. They nest in tangled thickets near the ground. The nests are larger and not always suspended. They lay three or four eggs in May or early June. They are white, sparingly speckled with brown.

The Warblers are the most beautiful, useful and interesting birds that we have. They are useful in that they feed largely upon injurious insects. They are very active, always flitting from branch to branch, and showing their plumage to the best advantage. Their songs are simple but effectively delivered, and their nests are clever works of architecture.

The Black and White Warbler is usually seen creeping along branches much in the same manner of a Nuthatch. They are of great value to man. Their nests are placed on the ground in swamps or woods. They are built of strips of bark and grass, placed among leaves, usually by a stone, stump, or fallen tree. They lay three to five eggs, white, finely speckled with reddish brown.

The Worm Eating Warbler can always be identified by the three light buff and two black stripes on the crown, and narrower black stripes around the eye. They feed largely on the ground, among dead leaves. The nest is made of leaves, grasses and rootlets, lined with hair or fine grasses, usually placed under the shelter of some small bush. In June or July they lay three to six white eggs marked with chestnut or lavender.

The Yellow Warbler is a common species that is wholly yellow, being more or less greenish on wings and tail. The male is streaked on the sides with chestnut. They nest anywhere in trees and bushes, in woods, parks, or dooryards. The nests are usually placed in upright forks of trees and is made of fibers, fine grasses woven compactly together, and lined with plant down and hair. They lay in May or June greenish white eggs speckled with brown and lilac.

The Cerulean Warbler is a beautiful bird, light blue-gray above, streaked with black on the back, white below, with a grayish-blue band on the breast and streaks on the sides. They have two wide white wing bars and spots on the outer tail feathers. They build their nests usually in the forks of trees twenty or more feet from the ground. The nests are made of fibers, rootlets, etc., lined with hair. The eggs are white or a pale bluish white, speckled with reddish brown.

The Chestnut Sided Warbler may be readily known by the white underspots and the broad chestnut stripe on the flank, and yellow crown. They live in low brushes in open woods or pastures, nesting usually within three feet of the ground. The nests are often concealed beneath the leaves in the tops of small bushes. The nests are made of grasses, weed stems, and some fibers, but their nests lack the wooly appearance of the Yellow Warblers. Their eggs are white or creamy white, speckled with brown and grey.

The Bay Breasted Warbler has the crown, throat and sides a rich chestnut, underparts white, forehead and face black. They choose coniferous trees in swampy places for their nests, making them of rootlets, bark shreds and placing them in horizontal forks five to twenty feet above the ground. The three or four eggs are laid in late May or June, are white, usually heavily spotted with amber, reddish brown, or gray.

The Black Poll Warbler is black and white and has a solid black cap. The underparts are white, streaked with black on the sides. While they bear some resemblance to the Black and White Warbler, they do not have the creeping habits of that species. They nest in stunted pines or spruces, making their nests at low elevations of rootlets and lichens, lined with feathers. The eggs are a dull white, splotched with neutral tints.

The Sycamore Warbler has grey upper parts with two white wing bars, the throat and breast are yellow, the cheeks and the streaks on the sides are black. The nests are usually on horizontal branches of sycamores and are three to five in number, pale greenish white, speckled at the larger end with reddish brown or grey.

The Oven Bird is sometimes known as the *Golden Crowned Thrush,* because of its brownish orange crown bordered with black. They live only in the woods, building their nests on the ground, arching over the top with rootlets and leaves, the nest itself being made of grasses and leaves. The eggs are four to six in number, white, glossy and spotted with brown and lilac.

The Mocking Bird nests about houses, open fields, woods and roadways. Their nests are bulky affairs of twigs, leaves and grasses, placed in trees and bushes at low elevations. The eggs, three to five in number, are dull greenish blue, spotted with brown.

The Cat Bird is a well known mimic and frequents open woods, bridges, and hillsides. Their nests are usually low in trees and constructed similarly to the Mocking Birds. Their eggs are laid in May or June, three to five in number, are a bright bluish green in color, and are unmarked.

The Brown Thrasher is a handsome songster, is often found nesting near the Catbird. The nests are similar, but that of the

Thrasher is usually more bulky. They lay three to five eggs in May or June. The eggs are white or greenish, profusely spotted with brown.

The Carolina Wren is a well known loud voiced songster found along streams, walls, brush heaps or thickets. They nest in almost any suitable nook or corner, in hollow trees, in stumps, around buildings, in bird boxes, in brush or bushes. The nest is made of all sorts of trash and if exposed is arched over. There are often several broods raised each season. The eggs are white, speckled with brown and lavender.

The House Wren is a familiar noisy little fellow, and is the most common of the wren family. They are found in woods, swamps, fields, pastures, around houses, in bird houses, or in any nook that may suit them. They lay from three to nine eggs in a set, and frequently three sets a year. The eggs are pinkish white, but are so thickly dotted with brown, that they appear to be almost a plain salmon color. They fill any cavity they choose for a nest with twigs, grass, feathers or hair, and here lay their eggs.

The White Breasted Nuthatch is a creeper, and runs up and down trunks of trees. Their plumage is grey and black above with a black crown and white below. They nest in holes in trees, usually in deep woods. They build at any elevation from the ground, often in deserted woodpecker's holes. They line the cavity with feathers and strips of bark. During April and May, they lay four to nine white eggs, speckled with brown and lilac.

The Red Breasted Nuthatch has reddish brown underparts and a black stripe through the eye. They lay four to six white eggs spotted with brown.

The Tufted Titmouse has a greyish crest and upper parts and is white beneath with brownish sides and black forehead. These noisy birds nest in natural cavities or holes left by woodpeckers. They are found at any elevation, and line the bottom of the hole with leaves, bark, or hair, and during April to May lay five to eight eggs, speckled with brown.

The Chickadees are the favorites with almost everybody of all North American birds. They breed in holes of trees, in orchards or woods and in bird boxes. They line the hole with fine grasses and feathers, and in May or June lay five to eight white eggs dotted with brown.

The Carolina Chickadee has little or no white edging on the wing coverts. Otherwise they are much like the above.

The Ruby Crowned Kinglet is about 4½ inches long. It has a partly concealed patch of red on the head, not bordered by black. They build their nests in coniferous trees, any height

from the ground. They lay four to nine eggs, creamy white, flecked with brown.

The Blue Grey Gnatcatcher is a graceful bird, blue grey above, with a black forehead, central trail feathers and white underparts. They usually build at a good distance from the ground. The nests are made of plant fibers and down, lined with cottony substance and hair, and covered on the outside with lichens to match the limb on which it hangs. The eggs are bluish white, speckled with chestnut.

The Wood Thrush has a brightly spotted breast and is one of the most handsome of the Thrushes. They breed in thickets and damp woods. Their nests of leaves, straw and grasses are usually placed in the low trees, four to ten feet from the ground. They are rough looking bulky structures. During May or June they lay three or four greenish blue eggs of about the shade of a Robin's.

The Robin nests in trees, in orchards, woods, around houses, or in almost any conceivable place. The nest is made of grasses, firmly cemented together with mud, and lined with fine grasses. Their eggs are bluish green, and may be found any time from May until July or even August, since they raise several broods a season.

The Blue Bird usually builds in cavities of trees within 20 feet of the ground in bird boxes, or in any suitable crevice they may find around buildings, provided the English sparrow is not allowed to bother them. They begin to lay in April when they lay three to six pale bluish white eggs. They raise several broods each season. The cavities are usually lined with grasses and feathers.

NOTE—*The above brief outline is by no means a complete study of the birds of the neighborhood. If from it the student is led to identify even a few of our common birds, its mission will have been accomplished. It is merely suggestive and it is hoped that the students will be interested enough to continue the work farther, and secure one or more of the many excellent bird books or guides now on the market.*

Bird Groups; Permanent; Summer and Winter Residents; Migratory Visitors

Our birds may be grouped under the three heads—permanent, summer, or winter birds. The migratory visitors are really but temporary residents—that is they stop en-route as they are going somewhere else in their travels North and South.

We will list the permanent residents first. The ones marked thus * are most common.

1. Bob-White. 2. Ruffed Grouse. 3. Red Shouldered Hawk. 4. Red Tailed Hawk. 5. Sparrow Hawk. 6. Cooper's Hawk. 7. Sharp-shinned Hawk. 8. Screech Owl. 9. Barred Owl. 10. Great Horned Owl. 11. Long-eared Owl. 12. Short-eared Owl. *13. American Crow. *14. Blue Jay. 15. Flicker. *16. Meadow Lark. *17. Downy Woodpecker. *18. Hairy Woodpecker. *19. English Sparrow. 20. Purple Finch. *21. Song Sparrow. *22. Goldfinch. *23. Chickadee. *24. White-breasted Nuthatch. 25. Cedar Waxwing. *26. Blue Bird.

The winter visitors are those which come in the fall and remain until spring. They include:

1. Saw-whet Owl. 2. Prairie Horned Owl. *3. Junco. *4. Tree Sparrow. *5. White-throated Sparrow. 6. Redpoll. 7. American Crossbill. 8. White-winged Crossbill. 9. Pink Grosbeak. 10. Pine Grosbeak. 11. Siskin. 12. Northern Shrike. 13. Snow Bunting. 14. Winter Wren. *15. Brown Creeper. 16. Red-breasted Nuthatch. *17. Golden Crowned Knight. *18. Hermit Thrush.

The summer birds are too numerous to mention. Most of them have been discussed earlier, and include Blackbirds, Doves, *Robins, *Phoebe, Warblers, *Swallows, *Thrushes, Martins. Sapsuckers, Tanagers, Nighthawk, Whip-poor-will, Woodpeckers, Buntings, *Vireos, *Wrens, Cuckoo, Humming Birds, *Orioles, *Bobolinks, Grosbeaks, and a host of others.

Characteristics of Common Bird Families; Thrush, Black Bird, Flycatcher, Woodpecker, Shore and Swimming Birds Sparrow Family; Mocking Birds; Birds of Prey

The *Thrushes* and Bluebirds belong to the Turdidae family of the order Passers. They are beautiful birds, and include some of our best known garden and orchard birds and several beautiful songsters. It is a distinguishing mark of the family that the first primary is short, never longer than one-fourth as long as the longest.

The *Blackbird* belongs to the family Icteridae. To this family the orioles also belong. They like the thrushes belong to the order of Passers or Perching Birds. This order contains 19 families, about 150 species. Eighteen of the families are known as Oscines or singing birds, the other family as the Clamatores, or songless perchers. This last is the Tyramridal family. The blackbird famliy's members have a metallic black luster to their feathers often bright yellow heads as the yellow headed blackbird, or scarlet wings as the red-winged blackbird.

The *Fly Catchers* are of the order Passers, suborder Clamatores, and the Tyranidal family. They are all insect eaters of the best type, most of the food being taken on the wing. The

fly catcher will dart from his perch, atch it with an audible snap of the bill, return to the closen prey, where he swallows his lunch and looks for more. The flycatchers include the King bird, Crested Fly Catcher, Phoebe, Wood Pewee, and others.

The Woodpecker is of the order of Pici, and of the family Picidae, which include the Sapsuckers, and flickers also. They are distinguishable for their habits of drumming and burrowing in trees.

Sparrow Family

The Sparrow family belongs to the order Passers and the family Fringillidae, which includes the finches, sparrows, buntings, linnets, grosbeaks, crossbills, and longspurs. It is one of our largest bird families including 38 species. Its tail is closed, showing a distinct fork, double rounded, or closed tail square.

Mocking Birds

Mocking birds belong to the order Passers, and the family Mimidae, including the Thrashers, Mocking birds, etc. The Mocking bird is larger than the Catbird but resembles it in shape. It has ashy grey upper parts, and soiled white lower. Might be confused with a shrike except for the shrike's bill and head.

Shore and Swimming Birds

Order 1. Pygopodes—Diving Birds, including Grebes, Loons, Auks, and Murres.

Order II. Longipennes—Long Winged Swimmers, including gull chasers, gulls, and terns.

Order IV. Steganopodes—Swimmers, including cormorants, pelicans.

Order V. Anseres—swans, ducks, geese.

Order VII. Herodiones—Herons, Ibises, Storks.

Order VIII. Paludicolae—Marsh Dwellers include cranes, rails, coots.

Order IX. Limicolae or Shore Birds. These include the Phalaropes, Stilts and Avocets, Snipes, Sandpipers, Woodcock, Curlew, Plover.

Most of these birds are not common in our state. If interested consult Michigan Bird Life by Barrows, Michigan Agricultural College.

(*Note renumbering. Orders III and VI seem missing. They are not shore or swimming birds, so are not included.*)

Birds of Prey

Birds of Prey belong to the order Raptores, and are distinguishable by the shape of the bill and the feet. The bill is strongly hooked, with a cere. Usually three of the toes are

turned forward permanently. Claws are long, curved, and sharp. With the exception of the American vultures, the claws are acute, and flexibly jointed to the toes.

The birds of prey include Buzzards or vultures, kites, hawks, eagles, ospreys or fish hawks, owls.

Value of Birds

Birds around a home are valuable both because of their beauty and song, yet if these alone are not enough to make one encourage them to build near one's door, then the realization of their economic value surely will. During their nesting season the old birds have to work early and late to supply their young with food, and therefore make valuable insect destroyers. They feed largely upon grubs, cut worms and similar worms, which later in the season may cause the gardener or farmer much damage. Not long ago an actual count was made of the number of chinch bugs and destructive worms found in a bird's crop, and it totaled a surprisingly high number. The American farmer is just waking up to the real value of his feathered friends and is acting accordingly.

List of Ways in Which Birds are Valuable

An examination of the contents of birds' crops shows that 70% to 90% of their food is ground infesting insects and larvae. Hence one of the greatest value of birds is that they help the farmer rid his fields of insect pests. Again, their grain food is largely the seeds of weeds, and thus they prevent the spread of noxious weeds. Some birds of prey aid by destroying small animals, such as the field mouse. During the winter they feed largely upon insects and larvae which they find under the barks of trees, thus lessening insect attacks the following year. Lists of pests eaten by birds are:—potato beetle, boll weevil, chinch bug, grasshopper, cutworm, caterpillars, moths, ants, bugs, and squash bugs. In addition to these there are many others too numerous to mention.

Appreciation of Birds

It is only of recent years, that the farmer has begun to appreciate his feathered friends. He formerly thought only of the cherries, grain, or chickens that they ate. Now he begins to understand how valuable they are to him and is aiding them to build nests and raise their young. Birds like flowers, music, and the other beautiful things of life make life more worth living. The clear call of a bob-white, the trill of the dickscissel, or the song of the rising lark stir one as they come to him across a

sunlit meadow. Few of us but has been gladdened by the sight of the first robin in the spring busily at work getting his home ready for the summer months.

Bird Enemies

The chief enemies of birds are cats and sling shots, or air rifles. It is a cat's nature to prey on birds, and no matter how carefully they are watched, will satisfy their instinct at the first chance. The next enemy will cease to be an enemy when boys come to realize how wicked, cruel, and wasteful it is to shoot a bird. To see a little fluttering body fall to the ground a quivering mass of feather should sicken and shame any right-thinking boy. A few minutes before, the little creature had been busy helping rid the fields of pests and seeds, the next it is dead—a useless victim to some thoughtless boy. That little bird had as much right to live as the boy who shot it. This fact most states recognize now, and have passed stringent laws to protect our feathered friends. Some larger birds prey on smaller kinds, but cats and boys are the chief offenders against bird life. Snakes also eat young birds occasionally.

Bird Conservation; Bird Houses; Material for Nests

When we once realize that birds are of benefit around a home, the next question is how can they be attracted and cared for? This is not as difficult as it may at first seem. In winter one can attract them by placing food for them. If done regularly, soon they will come daily to their lunch counter for their meals. During the spring, bits of wool, strings, feathers or material which they can use to line their nests with will be appreciated. In the hot summer months a place where they can drink and bathe will have frequent visitors. Above all, build bird houses. If properly built and placed, few will go through the season displaying the "To Let" sign. For years the martin, the house wren, the tree swallow and the blue bird were the only ones that people thought would occupy ready built houses. Now it is known that many others which formerly ignored man-built houses are occupying them. Titmice, Nuthatches and Woodpeckers build new houses each year. Red headed and gold fronted woodpeckers will occupy built houses, while the downy woodpeckers has been known to find such a place a satisfactory home for his young offspring. Robins, brown thrashers and song sparrows prefer homes open on two sides. While some birds are satisfied with almost any sort of lodging, other require homes built to suit their requirements. Wrens and bluebirds will build in tin cans wired in convenient localities, but chickadees and nuthatches won't. Wood is the most satisfactory building

material. In order to shut out rain, entrance holes should be sunk lower than the nest. Do not leave protruding nails or screws. A perch at the front is not best, since it often invites the chattering sparrow. All houses should be able to be opened so they may be cleaned out easily. Provide for ventilation but prevent drafts. If painted, they should be a grey or green if in trees or if on poles, white.

If students are interested in this subject, they should write for Farmer's Bulletin 609, Bird Houses and How to Build Them, by Ned Dearborn. On page 4 of this bulletin is given a table of dimensions of nesting boxes for the various species of birds, which is very valuable.

Watering, Feeding and Care of Young Birds

While birds appreciate feed especially in cold weather, it is also most welcome when they are raising their young. The most we can do at this time is to supply the food for the older ones, and they in turn feed the young. Bits of meat placed near their water supply will be appreciated. Be sure the water basin is kept clean and well filled. Another attention they will appreciate is for us to keep all cats away while the young are learning to fly. Another thing too often overlooked is a supply of fine sand, or coal ashes. This the birds like and need when they eat seeds. Most of the food of the baby birds consist of larvae or other worms. If you want to see an old robin smile, put a supply of these some day near her water pan, then watch her while she feeds her babies.

Need of Woodland Preserves to be Used as Bird Harbors

Our wild life is slowly but surely vanishing with our native timber. To the farmer who still keeps his wood lot, the problem of attracting birds is a simple one. Bird societies throughout the United States made efforts to have woodland preserves maintained for their little charges, and where this is done, the birds congregate in great numbers. Most birds like to return to their old homes, and pairs have returned year after year to trees or clumps of bushes, where they lived the season before. If you wish to encourage your bird friends, spare your woodlot for their nests.

Landscape Gardening

By landscape gardening we mean the beautifying of any plot of ground. This may range in size from the small 30 foot city lot to estates with hundreds, even thousands of acres. On the smaller scale, the work is usually done in a more formal manner, with the house as a nucleus, around which trees, shrubs, and

flowers are grouped. In larger grounds, nature may be left undisturbed as far as arrangement is concerned, the work of the gardener being as a supplement.

In general landscape gardening includes the artistic arrangement of plants, placing of buildings in harmonious relationship and the skillful use of walks and drives.

Artistic Arrangement of Plants

The *artistic arrangement* of plants depends upon various factors: Size of grounds, number and position of buildings, climate, use of premises, and many others. Hence but general directions are possible here. First avoid a patchy arrangement of plants. Do not plant a rose bush in the middle of a green stretch of sod merely because there is room for it there. Shrubs are best banked around porches or in fence corners. Walks may be bordered with roses or bulb plants such as tulips. The largest plants naturally are placed in the background.

The habits of plants must also be studied in arranging them. Some require strong sunlight, others prefer shade. Their individual preferences must be considered. But above all remember that well kept stretches of green grass are the first requisite of a beautiful lawn and don't mar it by promiscuous planting of flowers or shrubs.

Buildings and their Relationship

In considering the question of landscape gardening, we must take into consideration the *number of buildings* and their *relation* to each other. As a rule, the location of buildings is fixed and the best we can do is to plan our scheme of gardening to conform to them rather than to change their position.

Even if this relation is unfortunate, a clever planting of vines, trees, making arbours, or laying out winding drives and walks will do much to lessen the defect. All barns, outbuildings, garages, etc., should be placed at a reasonable distance from the house. What this distance is depends upon the size of the lot, and the buildings in question. They will work in better with the general scheme if they conform in so far as possible with the general appearance of the house—that is if they are built of the same material, are alike in color and general lines.

Walks and Drives

Walks and drives are not only of use around a home, but they are an ever present help in time of trouble to the landscape gardener.

Have you ever noticed a stout, fleshy person dressed in checks, or a thin, scrawy one dressed in stripes? If the checks

were put on the thin person and the stripes on the fleshy, the effect would be far more pleasing. It is just the same with walks around a house. Straight drives and walks give a prim formal look to a place and are quite all right if that is the effect wanted. This calls for formal treatment of shrubbery and flower planting. However, the more "homey" effect is gained by bending walks, and drives that circle. But space must again decide this. The man with a city lot 30 or 32 feet wide is happy to have room for a straight drive for his "fliver." The grace of curving drives is left to his more fortunate neighbor of the large yard. Such a yard of limited space is best bordered with a low cut hedge and a few flowers banked in the corners of the yard or against the base of the house and porch. Beware in limited quarters of overcrowding.

IMPROVING THE HOME GROUNDS

The Lawn and Its Care; Bluegrass

Americans within the past generation awoke to the fact that there was more in life than mere money getting. This awakening has extended not only to the middle and wealthly classes, but to the poor as well. One of its most noticeable results has been in the increased attention paid to the home and home grounds. Our parks and recreation grounds are but a further development of this same movement. Perhaps in the country this has been of the slower growth, owing largely to conditions there, rather than to greater indifference. On the farm there are so very many necessary things to be done that there is little time for the things one merely wishes to do. But so firmly fixed is the idea becoming in the modern up-to-date farmer's mind, that a beautiful well kept home and lawn is just as necessary as a well stocked barn or feed lot, that throughout the length and breadth of our land today, beautiful rural homes are now the rule rather than the exception. In the pursuit of a beautiful home and ground, the average farmer is usually at an advantage over the city neighbor. In the first place, he practically always has a greater stretch of space in the second, there are usually wonderful old trees, some of them native forest trees, that are generations old, and the third point of advantage is that he usually is better financially able to make improvements than his salaried brother of the city. Almost one of the first requisites of a beautiful farm lawn is a fence. A lawn over which farm animals and fowls wander at will cannot and never will be a thing of beauty. Concrete walks, skillfully laid out, are also a great aid in securing a neat lawn; however, a well kept gravel walk is equally attractive, but requires more care.

White is always an attractive color for a house in the rural districts, and since it is away from the smoke and dirt of the city, is usually a thoroughly practical color. One of the most attractive country homes the writer has ever seen in Illinois was in Christian County several summers ago. A gravel drive curved between a line of great oaks up to a large white house set well back in a spacious lawn. The old time shutters were painted a soft green which seemed to melt into the green of the bending trees, while a bright note of color was lent by the almost endless number of scarlet geraniums bordering walks, drives and porches. It was a most effective arrangement, and one requiring but a few hours of care each week. Chickens and pigs there were most surely around that farm somewhere, but that farmer had learned that chickens and pigs should have a place and be kept in it. One of the most common mistakes in planning a lawn is to cut it up into patches, placing old time flower beds here and there with little regard for line or detail. Modern methods of horticulture are forcing the realization home that there is nothing more attractive in the way of lawn decoration than long unbroken stretches of well kept grass. This does not mean grass knee high, gone to seed, or filled with weeds. A lawn mower has now become around every home not a convenience merely, but a necessity. Its judicious use aids much in keeping a lawn in order. A word of caution is needed to the city yard owners. That is, a lawn should never be watered when the sun is shining on it, nor should the grass be kept mown too closely during the dry, hot summer months. To do so may result in its burning out.

Often it is advantageous to add lime to the lawn. The best sort to use is the ordinary ground limestone (Calcium carbonate) or air slacked lime. These are easiest to handle and to obtain.

Kentucky *blue grass* makes the most satisfactory grass, but is slow in starting, so it is recommended that it be sown with red top and English Rye. Manure may be applied either in spring or fall, preferably the latter.

Starting a Lawn

In *starting a lawn* there are various ways to proceed, depending upon the condition of the ground. If there is a reasonable stand of grass, our first move should be to enrich the soil and encourage the growth already there. If there are bare spots, these should be dug up with a rake, and sprinkled over thickly with good clover and blue grass seed. Lime may be added if needed, also wood ashes are excellent as is well rotted manure. Sheep manure is especially good.

Caring for a Lawn

This we take it has been done in the early spring. After the grass has begun to come up, we will also find dandelions, plantain, and a host of other weeds. In spite of all remedies on the market for these pests the only real success the writer finds lays in a sharp kitchen knife and unlimited patience. For weeks it may seem that two dandelions come where you dig out one, but perseverence counts here as elsewhere, and if watch is kept and none allowed to go to seed, the worst is over the first season. However in a dandelion infested neighborhood, one is never entirely safe, and eternal vigilance is the price of a fine lawn.

It seems needless to state one should never water a lawn when the sun is shining but a walk down a residence street any hot day will show how often this is done. Another warning seems necessary. Do not cut the grass to closely during dry seasons.

Enemies of the Lawn

The *enemies* of a lawn are legion, and range from the little blind mole burrowing his way underground to Bobby with his new roller skates. Among the animal enemies may be listed moles, ants, dogs that persist in burying bones, rabbits, chickens, and last but not least children. Children should have their own play ground, for no lawn that is used as a play ground can ever be a thing of beauty or a joy to its owner. Croquet sets and swings have caused more ruined lawns than any other half dozen things combined. There are various weeds and small insects that sometimes cause trouble but each is seldom of serious consequence, and if they are, require care too technical to be treated here.

Shrubs, Their Characteristics; the Placing of Shrubs; Border Planting; Foundation Planting

Shrubs may be divided into many classes, and by different methods, but the main question that arises in the mind of a prospective purchaser for garden or lawn is size. As far as the habits of growth are concerned, shrubs may be divided into the three classes:

1. High growing, used largely as backgrounds.
2. The medium growing shrubs known as fillers which may be used before the high growing shrubs, just back of No. 3, the low growing or dwarf shrubs. These are known as facers. In addition to the question of size, we also have the question of shape. Some are upright, some arching or bending, some spreading.

In addition to the above *charactertistics,* that of flowering should be carefully considered when shrubs are planted. Color, size, and time of flowering are all very important. In the first place, great care should be taken to keep colors that clash apart. Pink and red, pink and purple, purple and red, and like combinations should never be placed together. However, if the blooming time of two colors is different, it does not matter if they are planted together.

Unless some very definite color scheme is being worked out, it is better to have variety in color. In choosing the Weigela one may have white, rose and red. The lilacs also offer a variety of colors to choose from.

The time of blooming is also another most important consideration. We should so select our shrubs that there will be a combination blooming period. If we select those that bloom all at the same time, the blooms come and go, and the yard is soon without flowers.

Beginning in the early spring even before the leaves appear, we have the Forsythia, commonly known as Fortune's Golden Bell, or simply as Golden Bell. These bright yellow bell like flowers appear before the leaves, and lawns dotted with the bright brushes present a beautiful appearance. The Red But or Cercis comes next and adds a flaming note of color to the spring landscape. The Dentzias are next and are followed by the magnificent Spirea Van Houttei, which many call the one best shrub. It forms a beautiful billowy white mass whenever in bloom. After its blooming season is over it also makes an attractive shrub, because of its fine foliage and beautiful rich green. The Mock Orange or Syringa is the next shrub that blooms. Because of the profusion of its sweet wax-like blossoms it has long been a universal favorite. The High Bush Cranberry blooms a little later and is all too little known in this neighborhood. It is not only an attractive spring bloomer, but brilliant scarlet fruit soon follow the bloom. Such bushes and shrubs serve to attract birds to build their nests near, and anything that encourages these feathered friends is a decided asset.

Tamarix Africana is also a beautiful shrub little known here. Its beautiful soft pink is different from any other shrub, and has been described by one admirer as spray from an ocean breaker.

June is preeminently the month of roses. It is difficult to limit the discussion of roses to a few pages, if one says anything at all about them. Perhaps there is no flower that so thoroughly satisfies every requirement of flower lovers as roses do. In the first place, the variety of colors is almost endless. All known shades of yellow from the Persian yellow, a well known variety

of our grandmother's garden, to the long coppery buds of the Sunburst, are found. The pinks range from the dainty cream white pink to the warm rose pink of the Magna Charta. The reds show an endless variety from the soft red of the Liberty rose to the velvety black of the Gruss and Teplitz. The white roses are endless. The white Killarney is a favorite with many because of its double waxy leaves. The Kaiserin A. Victoria is another favorite among the white roses because of its beautifully shaped buds.

The La France is also an old time favorite for its full beautiful flowers. They are very large, double, and a most thoroughly satisfactory cut flower. But the most remarkable rose that has appeared on the market in a long time is the Paul Neyron. Its long, straight, sturdy stalks grow to a height of five feet or more, bearing immense flowers of a deep rose color. The stems are nearly thornless, and the buds very desirable for cutting. Among the most satisfactory roses the writer has had experience with, however, are the Richmond, and the Gruss and Teplitz. Both bear magnificent velvety blossoms of dark crimson, beautiful and lasting. They also withstand the winters well without much protection. From the Gruss and Teplitz, flowers may be cut from May till November. One cannot omit at least some mention of the Ramblers in their discussion of roses. The three most successful ramblers are the well known Crimson Rambler, Dorothy Perkins, which bears immense clusters of double pink, fragrant flowers, and the Baltimore Belle, likewise a pink rambler, a well known old time favorite. All three succeed with little care, and are most ornamental if trained over fences, porches, or lattices. Many unsightly fences and buildings may be turned into things of beauty if covered with these runners.

In discussing flowers that bloom in June, the lilacs should receive their share of attention. No landscape planting is complete without lilacs. They have been a prime favorite for years with all flower lovers, but new methods of budding have given us shades and sizes our grandfolk knew nothing about.

Spirea Billardi is a spreading shrub that grows to the height of five or six feet and flowers usually in August and hold over until early fall. In the fall we have the Hydrangeas and the Hibiscus, or Rose of Sharon. The latter comes in a variety of colors and is too little known. Its chief objection seems to be that it is easily winter killed.

Among the shrubs bearing berries in addition to the High Bush Cranberry already mentioned, may be given the Barberry, bearing long red berries which last throughout the winter, the Snowberry, which bears large clusters of snow white berries in

the fall and the Rosa Rugosa, which bears its red berries throughout the summer the same time shrubs are blooming.

The Placing of Shrubs

The placing of shrubs is a most important question, and one likely to be undervalued by the amateur lawn maker. In planting shrubs, we must bear in mind that we wish, consciously or unconsciously, that the finished product will be a harmonious whole, with the house the center from which all other decorations radiate. To secure this, we must not set shrubs here and there promiscuously wherever chance shows a bare spot. First, a large open front lawn must be left. If small, its apparent size may be increased by effective shrub grouping. The view from the front of the house should never be obstructed unless the house is placed too near the public street, and the desire is to screen it from view. Often unsightly fences and buildings need to be screened from view. This will be discussed further under our treatment of vines.

The main use of shrubs around a house is to make it blend with the landscape to form a connecting length between horizon and house as it were. If one will but consider for a moment all the old deserted houses he can remember, he will find those that are half hidden by bending trees, tangled vines and overgrown shrubbery, do not present as desolate forlorn appearance as some tall, gaunt house perched upon a bleak hill top unguarded by tree, bush, or shrub.

Unless a garden is intended as a formal garden, one should avoid monotony in shrub planting. On the other hand, one should avoid patching effects. The nice distinction between the two marks out the skilled and landscape gardner from the amateur.

Border Planting and Foundation Planting

There are two chief methods of planting—*border* and *foundation planting*. The tall groups should be used for foundation planting, and *always* planted first. If in a round clump they should be put in the center; if at the side of a building, they should be placed in the background. Then in front of or around the foundation shrubs, we may use the medium size shrubs or fillers. Then next we may plant the dwarf shrubs or facers. A very important thing to remember in planting shrubs is to remember that nature very rarely ever places a single specimen of shrub alone. She always plants them in groups, hence to avoid the spotted, patchy look so often seen in yards and gardens, several of each kind of shrubs should be placed in small groups.

Vines

Vines are very adaptable plants and may be used in various ways. Around the porches they are useful to give greater privacy. Hall's Honeysuckle is a favorite for this, as is the Chinese Wisteria, the Japanese Clematis, and American Ivy, a very artistic effect is often obtained by a combination of two or more of these vines. The Dorothy Perkins rose, Japansese Clematis, and American Ivy make a good combination, as do the Chinese Wisteria, Dorothy Perkins rose and Climbing American Beauty rose. The American Ivy, Baltimore Belle rose, and Hall Japan Honeysuckle are also good "mixers."

Any of these combinations are also excellent for arbors that one wishes entirely covered. Unsightly objects may be quickly covered with Amercian Ivy, Wisteria or Dorothy Perkins rose.

American Ivy and Boston Ivy are the best plants to use in covering houses. They cling to the wall by means of their own stems, and over brick, stone, or concrete houses, form a most delightful covering. They also make the houses much cooler in summer. The famous old castles throughout Europe have been covered for centuries by ivy vines.

Honeysuckles and Dorothy Perkins roses are recommended for covering steep banks.

Annual; Perennials

Annuals are those flowers which must be replanted each season. These include some of our most beautiful summer flowers, but are usually much more trouble than the biannuals or perennials. They require more care, and during the dry months require frequent waterings. Perhaps the most popular of the annuals are Nasturtiums. If planted early they have their blooming season over before the dry weather begins. Their spicy fragrance and vivid colors make them especially welcome as table flowers, when arranged in low bowls. The sweat pea comes somewhat later than the nasturtium, but easily rivals it in favor. There is a peculiar daintiness both of form and color about this flower that endears it to all flower lovers. However, since the vines soon die, if the flowers are not gathered, it requires almost daily care to keep a good crop of flowers in bloom.

Asters and Cosmos are the popular fall annuals and are justly so. Both require little attention and reward one with a profusion of gorgeous colored blooms during the fall.

The students should add to this list of annuals, giving their experience in the past in raising the various kinds.

Perennials

By perennials, we mean plants that live from year to year without replanting. A nasturtium is an annual, for it lasts but a year, while a poeny is a perennial in that it lives from year to year. Some recommended for a country garden are: Monkshood, Columbine, Hollyhocks, Larkspur, and Bleeding Heart.

Flowering Plants

A volume might be written on flowering plants. They include both annuals and perennials, most of which have already been mentioned. Violets, bloodroots, hepatica, spring beauties, anemones, columbine and many others are among the native flowers. Phlox, dalilias, hollyhocks, pinks, sunflowers, nasturtiums, verbenas, mignonette, candytuft and larkspur are also recommended. If we wish to have our flowers from the bulb plants there are crocus, tulips, hyacinths, lilies, and narcisis. Geraniums also make desirable blooming plants for almost the whole year around.

There are many others such as the fuchi, begonia, and others recommended only for pot culture.

Hardy Perennials; Some Good Varieties for Colors Effect

Among the hardy flowering perennials we find many well known popular flowers. Chief among these are the *Peonies, or Pineys,* of our grandmother's garden. These range in color from pure white, shell pink, salmon, rose, to deep crimson.

Phlox come in white, pink, and red, and any border of hardy perennials is incomplete without Phlox.

The Blanket flower is on of the best of the perennials. It has large daisy-like flowers, with dark reddish grown centers blending through all shades to orange crimson at the petal tips. It grows about two feet high.

The Foxglove grows about four feet high, blooms in July and August. It is a well known favorite with rose colored bell shaped flowers, densely arranged at the ends of slender branches.

Chrysanthemums range from white, yellow, various shades of red, pink, blue, and purple with wonderful combinations of different colors. The better known garden type is pink, white, or yellow, and grows about three feet high.

Golden Glow is an excellent tall growing, hardy perennial plant, with immense bunches of bright golden yellow flowers as large as dahlias on slender stems. It often grows seven feet tall.

The Iris of various kinds and colors is justly popular. The Japanese Iris has red flowers, borne on stout stems three feet tall. It blooms in June and July. The German Iris blooms in May and June, and is blue, white or yellow.

Mallous are hardy perennials resembling the old time Hollyhock. It grows to be five feet tall, blooms in July and August, both pink and white flowers.

The Rocky Mountain Columbine grows to the height of about two feet. In early spring, it bears showy, light blue flowers on slender branches.

The Oriental Poppy is a thrifty grower, and often reaches three feet or more. It has immense flowers of a bright flaming scarlet color, wearing at the base of a cut, formed by the petals, a maltese cross of purple black.

The Wind Flower is a very attractive, rapid grower. The flowers are white with yellow center. It blooms from August till November. It is two to three feet in height.

Good Varieties for Color Effects. Little need be said on this subject in addition to what has already been said. Care should be taken not to plant flowers whose colors clash too near together. As a general rule, flowers with vivid glowing colors make most effective back grounds, while dainty delicate colors usually show up best if used against a background of plain green. Avoid monotony in a color scheme. The Golden Bell and Red Bud of early spring are daring bits of color that lend charm to the plain green of the early foliage. However, if anything is planted as a formal border, as tulips or geraniums, along walls or drive, a more symmetrical look is given to the arrangement if the flowers are of the same color and kind.

Be careful in setting roses to keep pink and red ones separated, also yellow and red ones. The question of placing for color effect is largely one of taste, however, and what would be a riot of beauty to one might be a clash of colors to another. It is a subject upon which ever landscape gardener differs, and as each person's lawn is largely for his own enjoyment, if it suits him and gives him pleasure, it will at least have accomplished part of its mission.

Annuals raised in the Neighborhood.

Under the annuals we can list most of the plants of which we buy seeds in the spring. They include nasturtiums, cosmos, sweet peas, astors, salvia, baby breath, some varieties of pinks, verbenias, and host of others.

Projects in Improving the Home and School Grounds.

Every child naturally loves beautiful things and if given the chance, will work to secure them. If parents and teachers would but make use of this desire, many improvements could be made both in the home and school grounds. If any care to do so by writing Stark Brothers, Louisiana, Mo., many useful and valuable suggestions will be given them without charge in regard to beautifying home and school grounds. A group of skilled landscape gardeners are kept who will personally answer any questions and submit drawings if desired of proposed improvements in lawns. It is suggested that teachers form clubs whose aims will be to undertake and carry out certain improvements around the schood grounds.